Tappi

HE JOURNAL OF THE TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY

AUGUST 1960

VOLUME 43 • NUMBER 8

NALCOAG® Adds ANTI-SLIP Features to Your Kraft, Boxes or Bags with Low-Cost 49-50% Colloidal Silica

Coating of Nalcoag Improves Load Stability, Reduces Slippage of Bags and Cartons During Shipping and Handling

Now you can add a *non-skid* feature, *another sales advantage*, to the paper and paperboard you make for use in shipping containers . . . and you can add it economically with low-cost Nalcoag colloidal silica.

Protect Products, People

Sliding boxes, bags and cartons are a dangerous and expensive problem. Damage to products during shipment is often traceable to slipping and sliding containers . . . and the possibility of falling bags and cartons is an ever present hazard to the men engaged in shipping, receiving and warehousing operations.

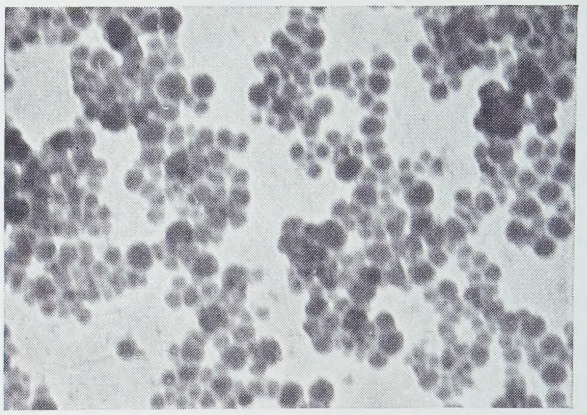
Nalcoag coatings create a frictionizing effect that greatly reduces the surface slippage. Bags and boxes stack higher with a far greater margin of safety . . . loaded forklifts travel faster, take steeper ramps and inclines with Nalco treated non-slip loads.

Improve Package Appearance

Even though a Nalcoag coating is invisible, it can produce visible improvements in containers. Treated bags and boxes have good soil resistance qualities . . . are cleaner, better looking on reaching destinations. And when a Nalcoag coating is applied *before* printing it has a sealing effect that reduces ink penetration, stops "feathering" and assures a sharper, cleaner package design that enhances customer appeal.

Economical, Easy-to-Apply

Effective frictionizing can be accomplished with very low dosages of Nalcoag. In some cases as little as 1/100 lb. of silica will treat 1000 square feet of paperboard, and seldom is more than 1/10 lb. required.



Silica particles in Nalcoag are so small they are hardly visible even in this photomicrograph at 65,000 magnifications. Nalcoag coatings on paperboard containers are not visible, but they create a powerful frictionizing effect on treated surfaces. Products packaged in bags or boxes are much safer during shipping, handling and stacking if the packages have a non-skid Nalcoag coating.

New Nalcoag 1050 gives you real economy in the highest silica concentration yet available . . . a highly stable, fluid, easy-to-use product of *49–50% silica!* It goes farther, lasts longer than the dilute 30% concentration now widely used . . . and it markedly reduces shipping, storage and handling costs.

Application of Nalcoag to sheet or board is relatively simple. Spraying, roller-coating and calender stack applications have all been used successfully and can be readily adapted to most mill operations.

Ask For Product Data, Technical Help

Nalco technical people are ready to help you make a better, safer, *non-skid* product. They will work with you *in your mill* . . . provide prompt, experienced assistance in establishing the best method of application and the optimum chemical dosage.

Product data on Nalcoag is ready for you, too. Why not write for it today . . . and ask us about *anti-slip* before your customers ask you!

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It takes more than deserving artwork and fine craftsmanship by an engraver to reproduce delicate colors and subtle-toned shading needed for realism. The paper itself, of course, is the final factor.

This picture is a sample of what you can get with Alpha Protein coated paper. Brilliantly white, truly opaque . . . ideal foundation for colors. Remarkable levelness to assure more uniform ink coverage. A cushioned surface to give sharp definition with less printing pressure.

Alpha Protein, a chemically isolated soy protein binder made by the Chemurgy Division, is rigidly controlled at all stages of manufacture for absolute uniformity. Availability and price fluctuations are never a problem. Its economy is quickly reflected in improved production speeds, faster drying, higher coat weights.

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25

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This is a sample of 4-color process lithography on Alpha Protein-processed paper

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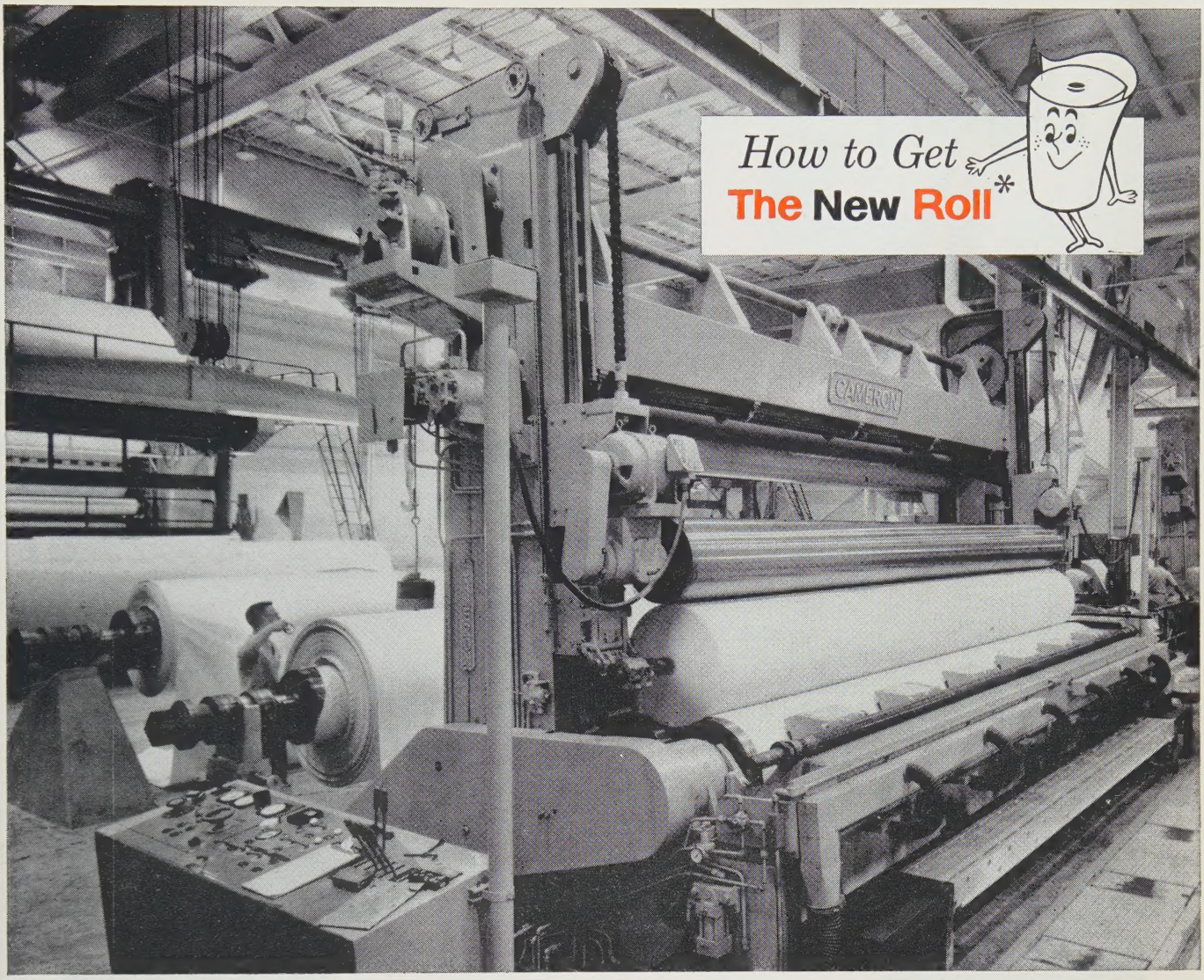

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In the action photograph above a new Cameron Imperial winding system, integrated from unwind to rewind, (246″ trim width, 72″ rewind capacity) is running at speeds up to 5000 fpm* on 28 to 85 lb. coated book papers. Here are some of the features of this job-fitted Cameron system:

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*Speed of Cameron Imperial is rated in excess of 8000 fpm depending upon machine width, number of cuts, tension, and characteristics of material.

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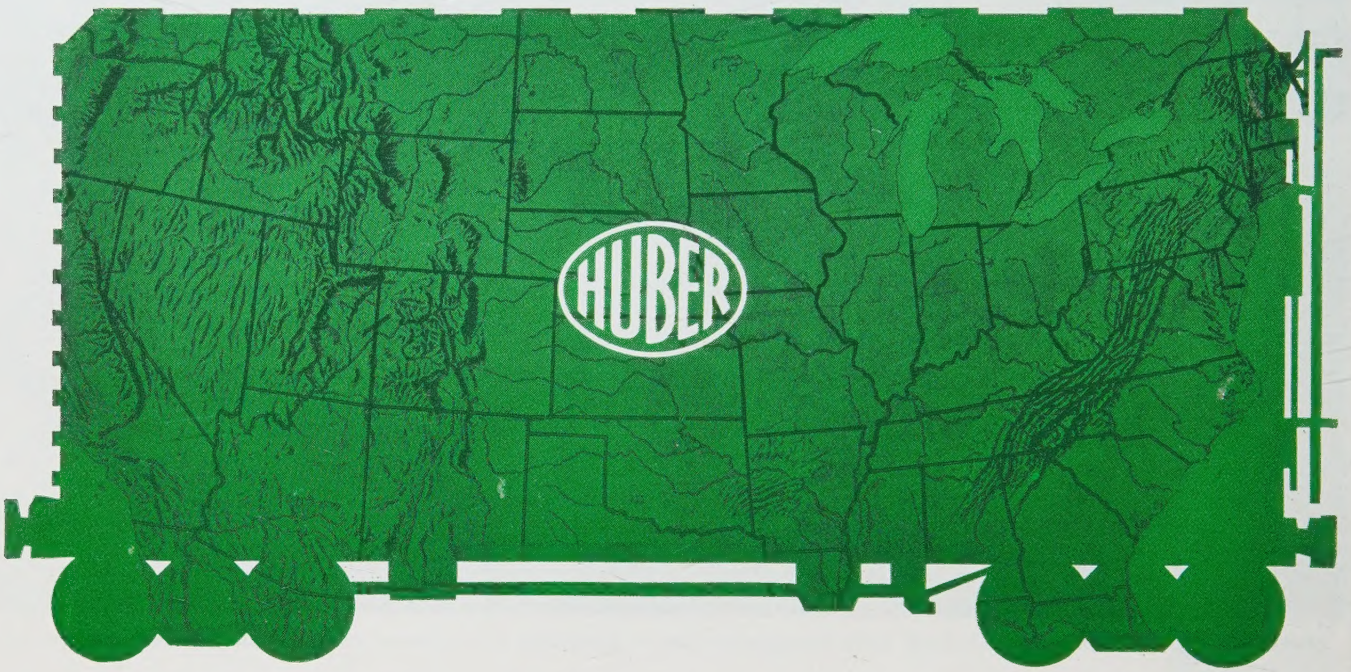

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Editorial and Advertising Offices:
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EDITORIAL DIRECTOR
R. G. Macdonald

EDITOR
R. T. Bingham

ASSISTANT EDITOR
Michael Kouris

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Calendar of National Conferences

Fourteenth Alkaline Pulping Conference
Multnomah Hotel, Portland, Ore.
Aug. 22–24, 1960.

Forest Biology Conference
Seattle, Wash.
Aug. 24–27, 1960.

Eleventh Testing Conference
Pantlind Hotel, Grand Rapids, Mich.
Sept. 27–29, 1960.

Tenth Corrugated Containers Conference
Royal York Hotel, Toronto, Ont.
Oct. 10–13, 1960.

Fifteenth Plastics-Paper Conference
Hotel Syracuse, Syracuse, N. Y.
Oct. 17–19, 1960.

Fifteenth Engineering Conference
Robert Meyer Hotel, Jacksonville, Fla.
Oct. 24–28, 1960.

Please refer to Local Section Activities for the locations and dates of Section meetings

"Many mills use our hydro in 2-stage groundwood pulp bleaching—and the new chip pulp demands a 2-stage bleach to reach the 75-plus brightness range"

Technical service supervisor Bob Barton and Tom Allan, assistant manager, Industrial Sales Department, Virginia Smelting Company, answer questions on 2-stage bleaching of groundwood and mechanical pulp made from hardwood chips.

Thomas T. Allan and Robert W. Barton

Q What is the economical break point between 1- and 2-stage bleaching?

Mr. Barton—There is no hard and fast rule, because so many factors enter in—the brightness level desired, the type of pulp, the cost of the present bleaching operation. Generally, I would say the break came at around 12 brightness points. A peroxide stage *can* be pushed beyond this. But to get a really appreciable gain at reasonable cost requires 2-stage bleaching—that is, one of peroxide and one of hydro.

Mr. Allan—Sometimes a mill using one stage of peroxide will use its bleached pulp storage chest for touching up the pulp with hydro and pick up a couple of points economically. It's usually cheaper than using peroxide. You see, the peroxide hits a flat point in its brightness-concentration curve. At that point it often takes another whole percent of peroxide to pick up one brightness point. And the cost is around $4 extra. For the same cost, five points of brightness may be obtained with a second stage hydrosulfite bleach.

Q Is 2-stage bleaching a way to be sure of getting high brightness?

Mr. Barton—Yes. To get the highest possible brightness in groundwood paper, the 2-stage bleach is the surest and most economical method. It seems to me the specialty paper manufacturers—the firms making special printing grades—will eventually require 2-stage bleaching.

Mr. Allan—That's right. Usually the 2-stage operation is chosen because brightness is the primary consideration. However, I do know of one mill that's considering going to 2-stage because of cost. They reach about a 72 brightness with one stage of peroxide, but the costs sometimes go up to $15 a ton. With a second stage the savings would be really worth while. I would say that the mill that wants to hit up in the 75-plus range just about *has* to go to two stages. And the competitive situation is beginning to make more and more mills consider this possibility very seriously.

Q Why is 2-stage bleaching so important with mechanical pulps made from caustic pretreated hardwood chips?

Mr. Barton—Because this is about the only way to get a high brightness from these so-called caustic pulps. And I think the chip pulp is going to have much wider use, largely because of availability of hardwoods. This pulp can be bleached with chlorine, but its final brightness is unstable, and the stock gets a definite yellow tinge. The process is rather different from bleaching groundwood. You start by acidifying and washing the stock. It is then bleached at about 180°F with 3% peroxide, using more caustic buffer than with groundwood, to get a brightness of about 70 points.

Mr. Allan—This stock has a very low initial brightness—about 40, I'd say. With 3% peroxide you can pick up about 30 points. Then to get the final brightness up where it's wanted, the pulp is bleached in a second stage with hydrosulfite to give a final brightness close to that of a bleached chemical fiber.

Facts on 2-stage bleaching

Yours for a phone call, wire or letter. We will send you any data you want—or, if you say the word, a representative will call on you at your convenience to discuss your problems.

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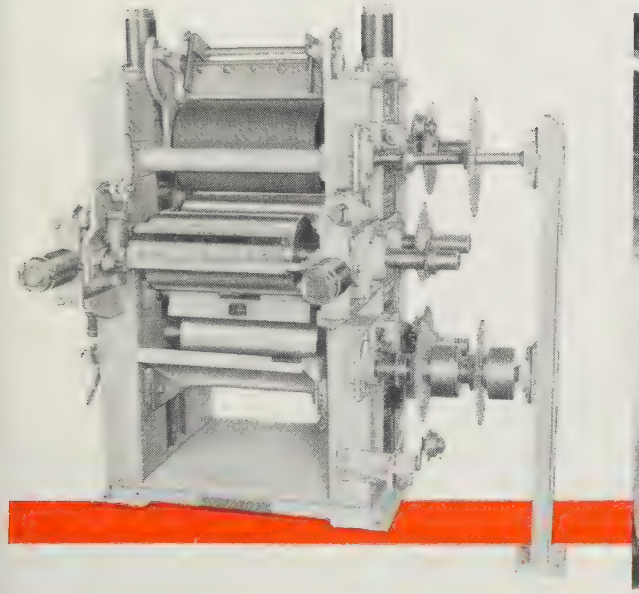

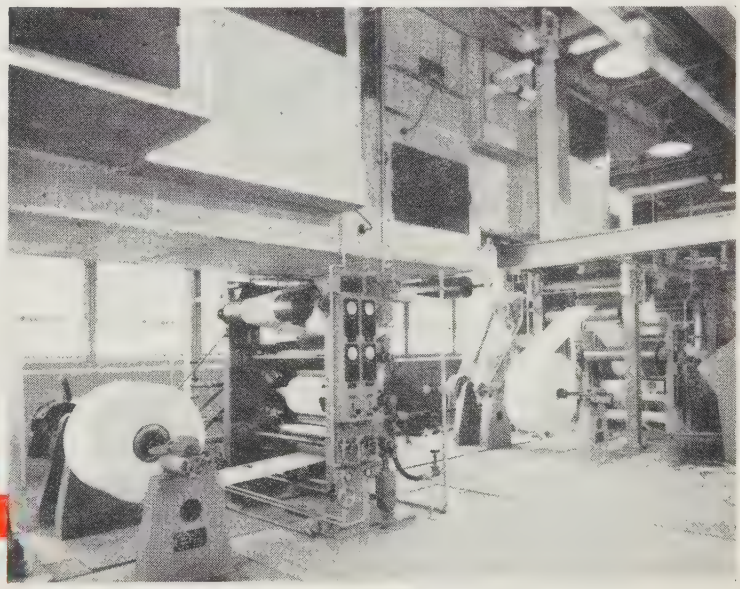

Present users of the Black-Clawson Universal Pilot Plant Coaters include Crossett Paper Mills, shown in above photo, Minnesota Mining and Manufacturing Company, Ozalid Division of General Aniline and Film Corporation, Oxford Paper Company, Koppers Company and many other major manufacturers.

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What Executive Management Desires and Expects from Technical Personnel and Technical Associations

HARRY H. SAUNDERS

When I was asked to make this talk, it was suggested that I talk along the lines of what executive management desires and expects from technical personnel and technical associations. Well, I have news for you. I think you picked the wrong man. If there is anyone in the pulp and paper industry who is nontechnical, I am it, and this being the case, why should I stand here and try to tell you what executive management desires and expects from technical personnel? But I was told that I was the person you wanted, so here I am, but I must warn you that what I say may be far different from what you might hear from any other representative of executive management.

In order that you may understand why it may be different, let me give you a little of my background. In that impressive introduction the chairman gave me, he did not tell you that I flunked the sophomore grade in high school. Not because I did not have the ability to make it, but because I wanted to go to work instead of going to school. Dad had other ideas, so he sent me to a good Methodist school in the foothills of Tennessee. Dear old Hiawassee. Six miles away from a town or a railroad or a hard surfaced road. A place where there was no after-school work to be had—nothing to do but go to school and study—so they thought. After seven weeks of this, the faculty decided that I had been disrespectful to them and I was relieved of my school responsibilities. Dad gave up then and told me that if I did not have enough sense to want an education that there was no use trying to force one on me, so I was permitted to get a job, which I did. It consisted of cleaning railroad coaches for a $1.10 per day—and in those times a day was 10 hours long.

In the ten years that I attended school, I went to nine different schools in six different towns in four different states. Now, going to school in this manner may not give you much education, but take it from me, brother, it does give you experience! I am sure that I learned reading, 'riting, and 'rithmetic while in school, but the only real lesson or rule that I can remember learning in school was the "Apple Rule." I well remember in the eighth grade when I was apparently being very dense in understanding a problem—my teacher brought out the "Apple Rule" and told me that if two apples cost 10 cents that even I should be able to figure out what one apple cost. Well, I wasn't too sure, but after securing two apples and two nickels I found that I could figure it out. The teacher told me that if I would just remember the "Apple Rule" that I would find it useful all of my life, I would find that most problems could be boiled down to a fundamental issue of "If two apples cost ten cents, then all I had to do was to figure out what one apple cost." And many a time since then I have used the "Apple Rule" in solving some rather complicated problem and in a highly nontechnical manner. I am sure that none of you would consider that there is anything technical about the "Apple Rule."

I have not given you this background because I am proud of it. There have been many, many times when I have been very sorry that I did not have more education. I doubt if there is one of you that appreciates the value of a technical education as I do. While I am strictly nontechnical, and technicalities bore me to distraction, I want you to know that there has never been a man who has had full responsibility of the operation of a pulp and paper mill, as I have, who has had to be so dependent on technical personnel and technical organizations and who has appreciated these people and these organizations as I have. So, even if I am nontechnical and really have no business giving this talk, at least it gives me the opportunity of thanking you for what you are, what you have done, what you are doing, and what you are going to accomplish.

When I tell you that I am nontechnical, please do not get the idea that I am nontechnical in a foolish fashion. I am not like the man who was sailing a big, new 40-ft. power boat in the channel between Southern California and Catalina in a thick pea soup fog and who was thoroughly lost. Suddenly, as you will in a fog, up loomed a sailing vessel. The man at the wheel of the power boat shouted "Which way to Catalina Island?" The man in the sailing boat was an experienced navigator, so he got out his parallel rule and laid a course on the chart. Then he called out "West by North by half a North." Whereupon the man in the power boat shouted back "Don't get technical—just point!"

And I think that everyone, regardless of how dumb they are, should acquire some technical knowledge and not subject people to the experience a man had who went into a large department store in Jacksonville, Fla., and walked up to the department which was selling citrus fruit. Plastered at every convenient location in the department were signs reading "We pay carrying charges on shipments to all points East of the Mississippi." The man purchased a couple of hampers of fruit and gave the clerk the address to which they were to be sent in Washington, D. C. When he asked the clerk how much he owed her, her reply was, "You will have to wait just a moment until I find out if Washington is East of the Mississippi."

And then there are cases where the technical man gets very nontechnical. Take the case of the doctor who had a patient who came to him with a very bad case of some kind of skin trouble. The doctor examined him thoroughly and at great length. Unable to diag-

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nose the case, but unwilling to admit it, and looking very perplexed, he asked the patient if he had ever had this trouble previously. The patient said yes, that some ten years ago he had the same trouble. The doctor brightened, smiled broadly and said, "Well, you've got it again."

Or take the case where people feel that they have to add something extra to their technical knowledge—such as the nurse who was so conceited that when she took a patient's pulse, she substracted five beats to compensate for her personality.

Wondering just what technical executive management might think about the question of what management desires and expects from technical personnel and technical associations, I took the liberty of writing to a good friend who is highly technical—who is president of one of the new pulp and paper companies now under construction—Mr. Gunnar Nicholson. I told him that in a moment of weakness I had accepted an invitation to make this talk tonight. I thought that he had possibly hired more technical men than any other one man in the industry and that fact, together with his long association with TAPPI, would make him the ideal man to give me advice. I asked him if he would be kind enough to summarize for me in one or two short paragraphs his ideas on the matter. I think that I insulted him by even suggesting that an answer to this question could be summarized in one or two short paragraphs. He was kind enough to send me a copy of a speech he deliverd at a TAPPI meeting a couple of years ago entitled "Technological Developments," which I found very helpful. I am not going to read his speech, but I do want to read to you one paragraph of his letter—

"I notice that you suggest that I summarize for you in one or two short paragraphs my thoughts in regard to technical personnel in our industry. I would say that you are oversimplifying the situation for, as you know, all modern industries are rapidly moving into a situation where practically all production people, even the hourly, will require at least an elementary understanding of technology, and this, of course, means that well educated and trained technical personnel become more and more a must if we are going to be competitive."

From my viewpoint, there are several things that I look for in considering applicants for a technical position. I will always favor a graduate from LSU, Auburn, Ga., Tech., or the University of Florida over the man from Harvard. The applicant from the southern schools will spend 75% of his time trying to do his job and 25% of his time trying to make the girls in the office, while the applicant from Harvard will spend 25% of his time doing his job and 75% of his time trying to figure out how he can get my job. Don't misunderstand me—I don't object to his trying to get my job, but I do resent his not paying any attention to the girls in the office. If there are any Harvard graduates here tonight, I will swear I said Yale.

We expect a technical man to have some common sense and to have the ability to either combine his technical knowledge with his common sense or to know when to use his technical knowledge and when to use his common sense, to know when to figure out his problems with his technical knowledge or when to apply the "Apple Rule."

We expect you to use a practical and common sense application of your technical knowledge. Don't let the fact that you do not have the advantage and experience of a nontechnical education get you down. Just how much value is your technical education if you do not have the common sense to apply it?

We also expect you to get nontechnical at times and share with us the burdens of community relations, and they are getting to be more and more important. Stream pollution, air pollution, Boy Scouts, churches, community drives, Little League baseball, and what have you. You are the part of management that can accomplish the most good in community relations. What you are, what you do, how you do it, means more to the company in the matter of community relations than anything executive management can do, except back you up in your community activities.

We also expect you to be actively interested in politics. When the best interests of the community can be served by your running for office, city commissioner, mayor, member of the school board, or what have you, then run for the office, and when elected, serve your community to its best advantage. Take an interest in each election, try to obtain the knowledge that will permit you to vote for the man who is best qualified for the office. Give him your active support. Pay particular attention to the men you support for the State Legislature and Members of Congress. They are the men who make the laws that you and your company have to live under. Make friends of these men when you have the opportunity. Invite them to talk at your meeting, and take advantage of the situation to talk to them and make friends with them. Invite them around to the house for a drink or a meal. Even a United States Senator will feel complimented that you asked him, and if time permits, he will accept. If he tries to show an interest and asks questions about your business, don't get technical with him. If he says something about stream pollution, don't get technical and give him the B.O.D. treatment. He will think you mean "Bodies on Display." Tell him what a good job the industry is doing in trying to protect the fishing for you, your family, and your friends. If you sell him on you and your interest in the industry, then your company's interest will be well taken care of.

One thing we do not expect of you—we do not expect you to get ulcers. We expect you to do constructive thinking about your job, your family, and your home and to have common sense enough not to worry about them. Constructive thinking will accomplish things. Worry will drive you nuts.

Some two thousand years ago, when the art of making paper was discovered in China, the Chinese and the Japanese had an art of making and/or applying lacquer. Today, with all of our science, all of our technical knowledge, we are not able to duplicate it. So the ancient art of making or applying lacquer has become a lost art. It's a lost art because, somewhere in the years gone by, the artists that had this "know how" either did not pass it down to their children, or some plague or war wiped out the entire colony of artists who had this knowledge. So the world lost a treasure. A lost art. Oh, we have fair substitutes—we make

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Whether or not your felts are so wide and so fast running that they need a Conditioner like this, they *do* need the continuous conditioning provided by a modern Vickery Conditioner. There is a size and type for every press felt on new machine or old.

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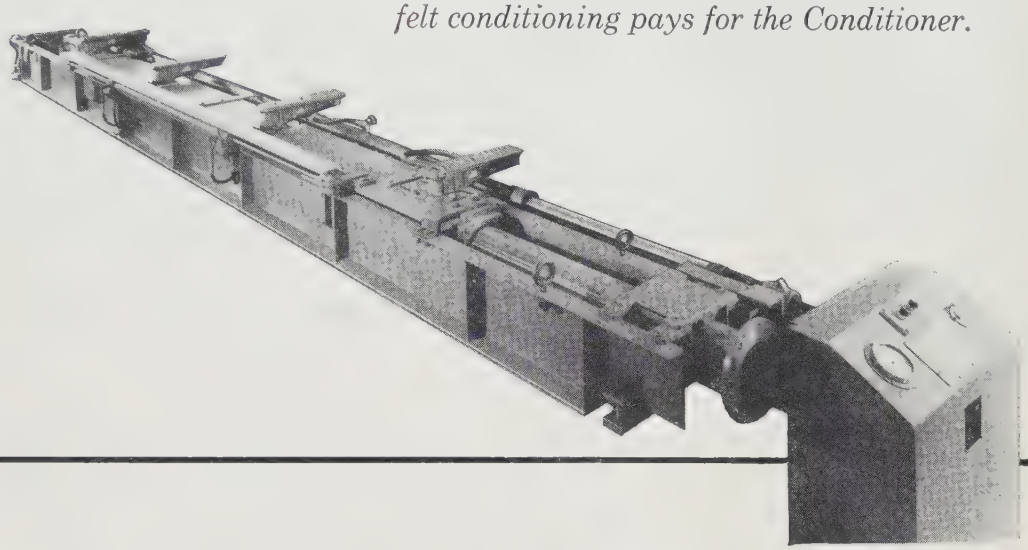

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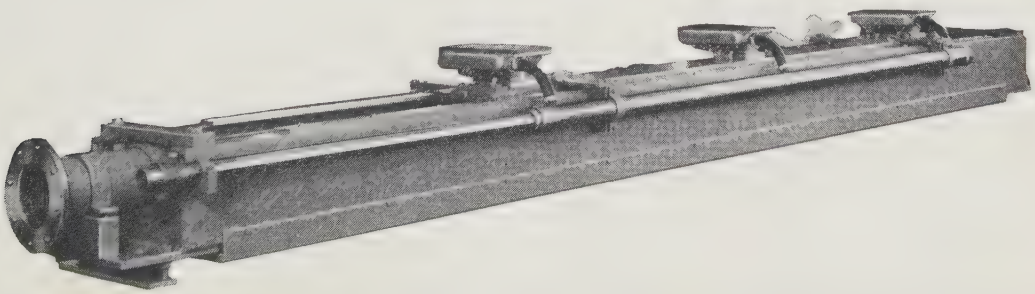

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out—but consider the irony of the situation when we cannot duplicate a process the Chinese and Japanese had centuries ago.

Fortunately, from the time the Chinese created the first crude sheet of paper, there has been a steady process of improvement in the art of making paper. Through all of the centuries and including today, the making of paper is an art. Thank goodness, nowhere along the line was it lost.

Man has used his faculties of seeing, hearing, tasting, feeling, and smelling to make paper and to improve the art of making paper. He has used the same faculties to invent machinery and develop processes to improve the art of making paper.

You only have to look back a few short years to remember when the digester cook was an individualist. It made no difference how the cook on the preceding shift had cooked the pulp or how high quality the pulp might have been, he was now king of the roost and by listening, watching, smelling, tasting, and feeling, he determined when and gave the orders to blow. The art of making paper.

There are very few of you who have not been in the business long enough to remember the time when the shift changed and a new machine tender took over. Well, it made no difference how the sheet looked or tested that was coming off the dry end of the machine, he took the attitude that the machine tender on the previous shift just did not know how to make a sheet of paper. So he changed this and he changed that and he changed those—two hours later we stopped having out and had a sheet on the reel that just did test a 100, whereas his predecessor had not had a break on his shift and not a test under 110—the art of making paper.

Well, it's still an art. We know that in the past 20 years we have made lots of progress. We have developed machinery and equipment that have made it possible to make a better sheet. Testing and control equipment has been improved to the point where we have instituted quality control. We have also used the science of chemistry to improve the art of making paper. We are meeting standards in the finished product that were thought impossible a few years ago. But the making of paper is still an art.

The art of making paper has progressed to the point where it is only going to take a few short steps over the threshold to enter that long sought for goal of the science of making paper.

This is the main thing that executive management expects of you and your organization. We expect you to take those few short steps into the science of making paper. You are the only ones who can do it and you have the opportunity of doing it now. It's not going to take more centuries to reach the goal. You will not have to wait on your successor to accomplish this transition. I don't know how long it will take, two years, five years, ten years—but I expect to live long enough to see it happen.

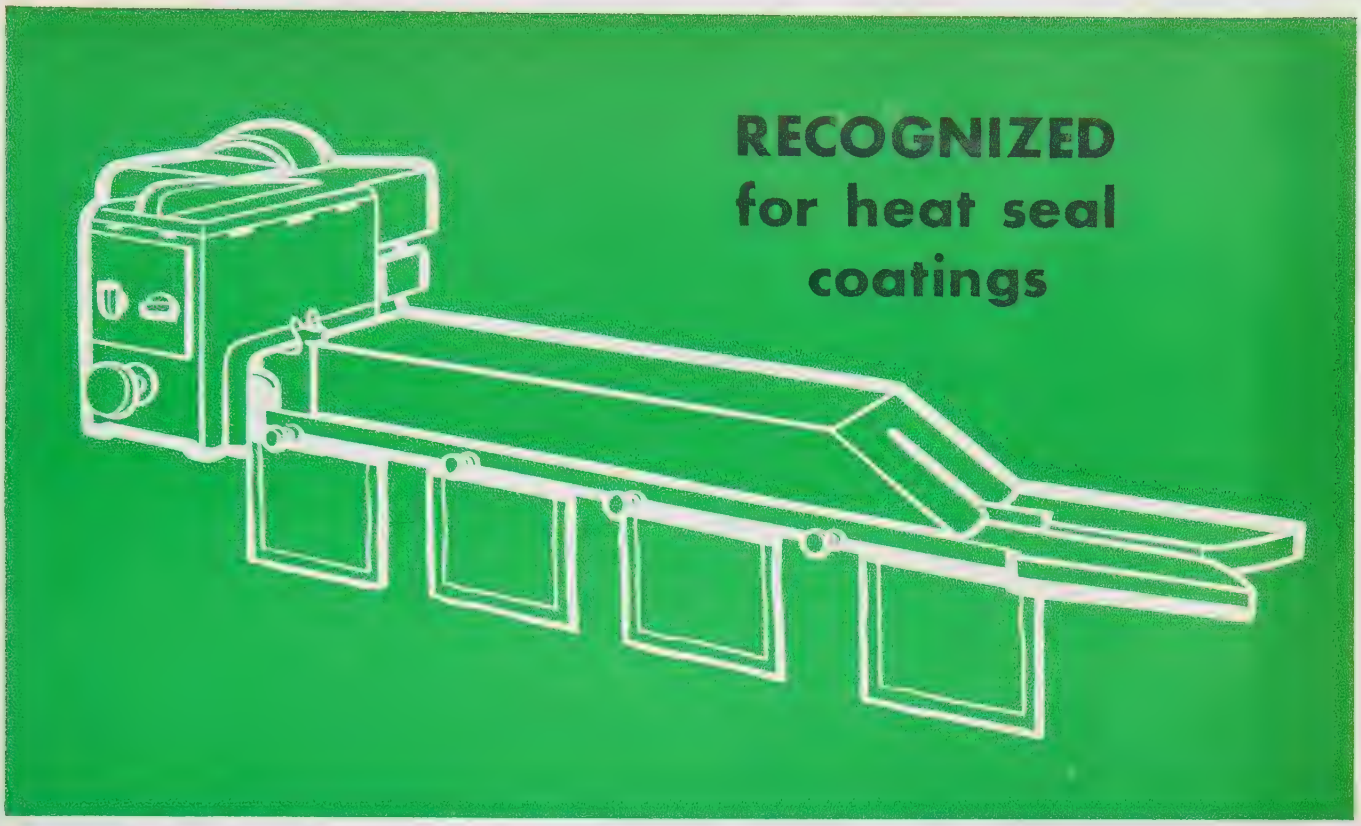
I would like to come back and talk to you on May 13, 1970. No, I would rather come back on that date and let you talk to me and tell me the things that you have accomplished—things that you have not thought about up until this time, and tell me all about the science of making paper.

A lost art—yes, papermaking is going to become a lost art, but thank God, it's going to be lost because of your technical knowledge. It's going to be a transition from an art to a science and not something that might have been lost for centuries. You men are living through this transition period. You are part of it. You are the men who are doing it.

What does executive management expect of you? We expect you to have the creativity to create and the flexibility to adapt yourselves to the new conditions that you will create. You are standing on the threshold of "The Science of Making Paper." We expect just that simple little thing of stepping over the threshold from the "Art of Making Paper" into that wonderful new world of the "Science of Making Paper." Art is giving away before the inevitable advance of technological improvements. You are the men who are going to write that little book called "The Science of Making Paper."

You are living in the most wonderful age of pulp and paper—the age of the art and romance of making paper. Certainly we want the "Science of Making Paper." Civilization demands it. But let me warn you—with the coming of the "Science of Making Paper" will also come the loss of the "Romance of Making Paper." You might as well recognize the fact that the "Romance of Making Paper" will be gone. Just thank God that you were part of the art, the romance, and that as civilization progressed you had the important part of being those that found how to make it a science.

Presented at the meeting of the Gulf Coast Section of TAPPI, held in New Orleans, La., May 13, 1960.



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GELVA EMULSION PROPERTIES CHART

Type	S-55 Homopolymer Dispersion	TS-22 Homopolymer Dispersion	TS-30 Homopolymer Dispersion	TS-70 Copolymer Dispersion	TS-85 Homopolymer Dispersion	C-3 Alkali Soluble Copolymer Dispersion	S-51 Homopolymer Dispersion
Total Solids (min.)	55%	55%	55%	55%	54.5%	54.5%	55%
Emulsion Viscosity, cps	1100-1300	350-650	1200-1400	900-1300	1400-1700	700-1000	3000-3800
Heat seal temp of film, °F.	195-205	195-205	200-210	170-180	140-150	145-155	250-260
Mechanical Stability	Excellent	Good	Good	Good	Good	Good	Excellent
Freeze-Thaw Stability	Very Good	Good	Poor	Very Good	Very Good	Poor	Good

Whether it's a heat seal coating for glassine or for paper . . . or even vinyl chloride, there's a GELVA emulsion for your application.

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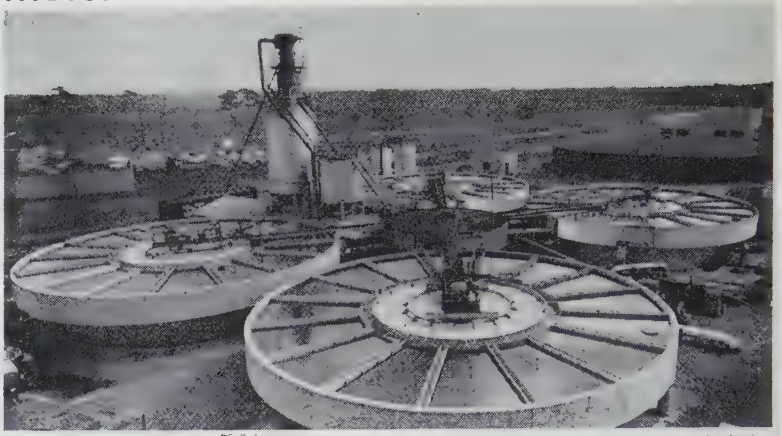

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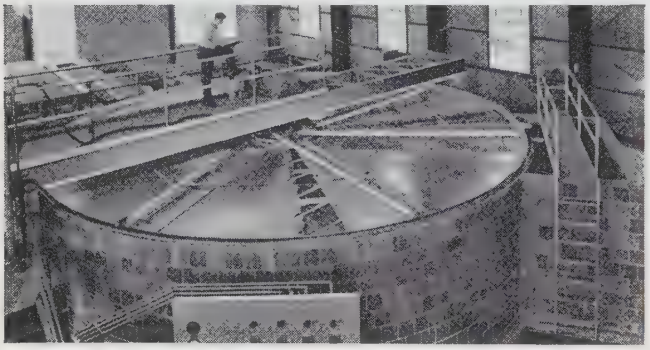

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The **SEDIFLOTOR®** clarifier is offered where space is limited and high-rate clarification is essential. This air flotation unit is ideal for removing floatable suspended solids and gives most effective fibre and heat recovery. **Bulletin 6051**

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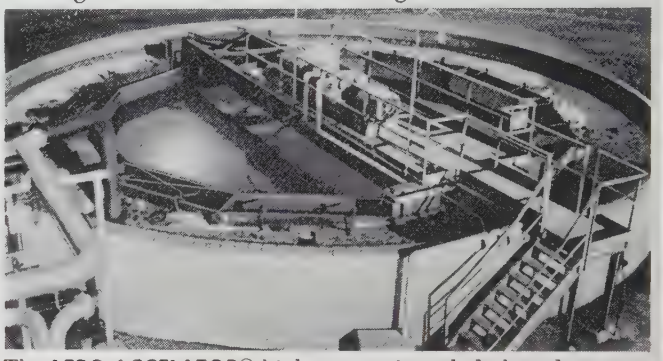

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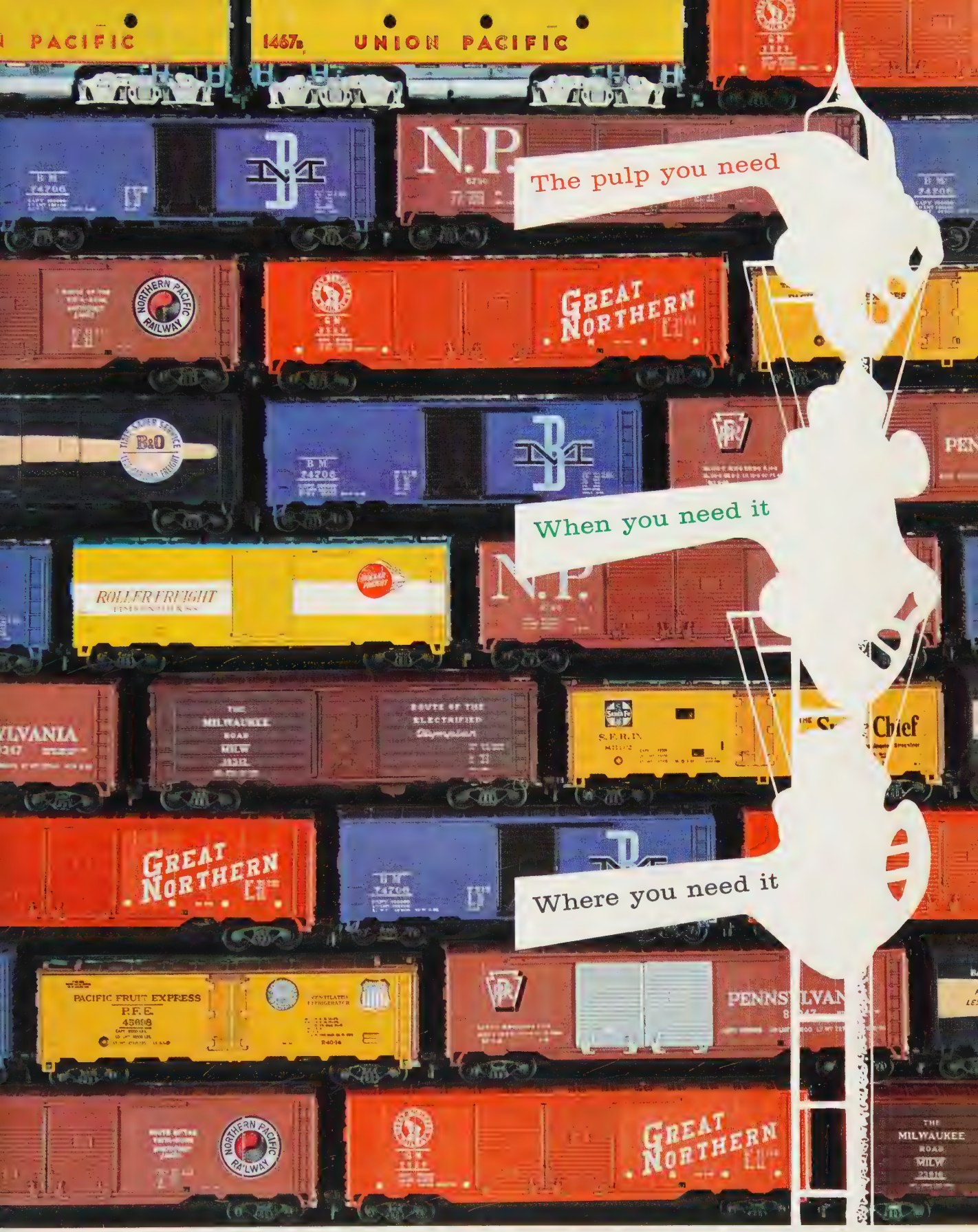

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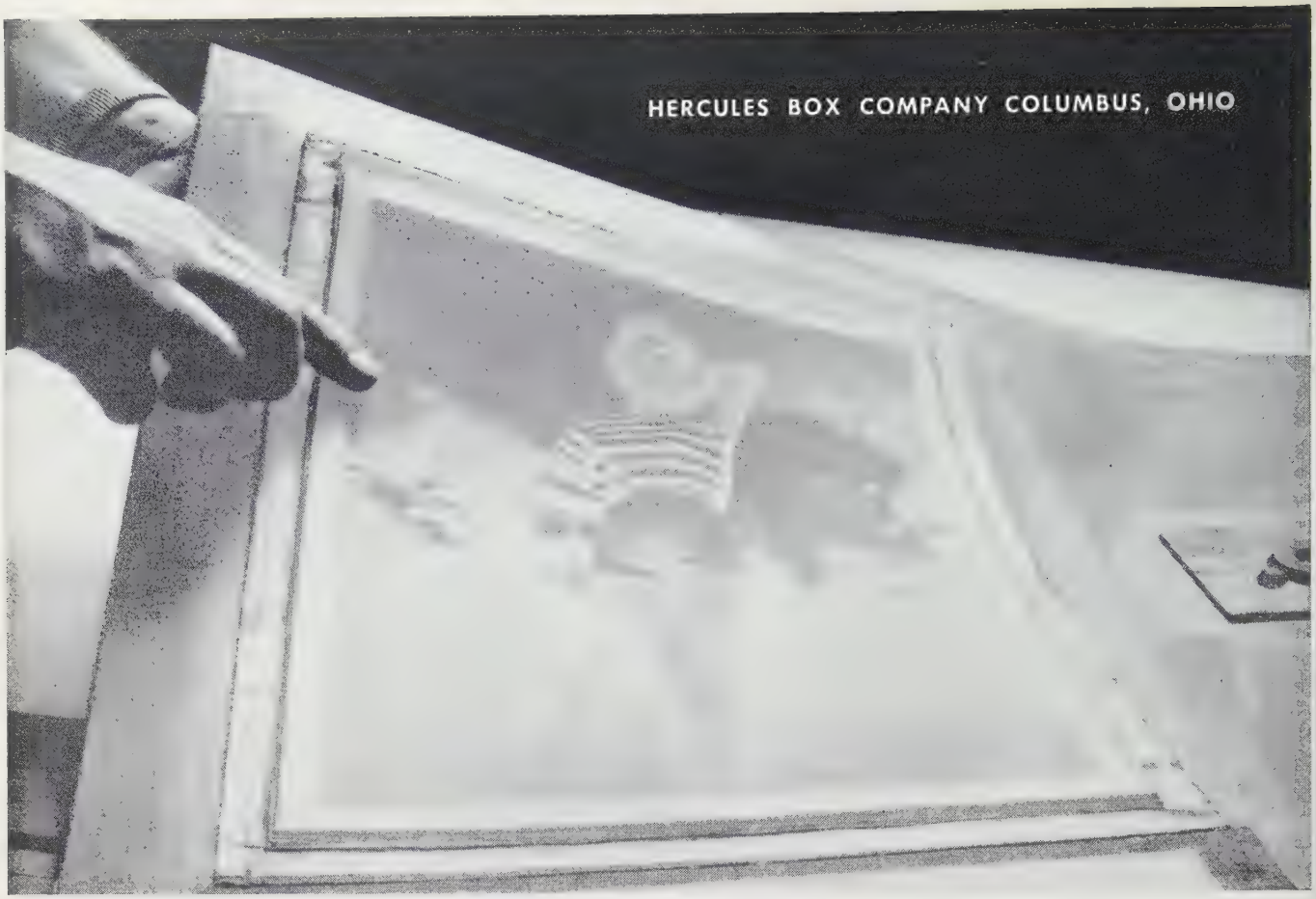

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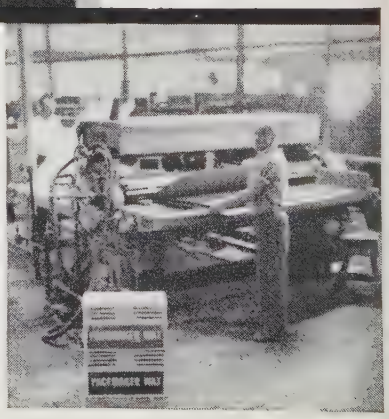

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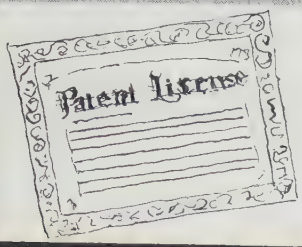

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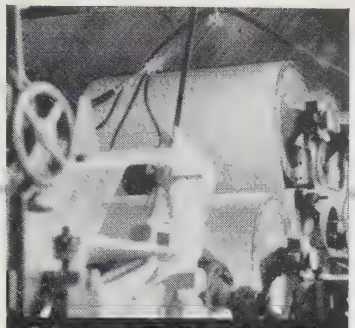

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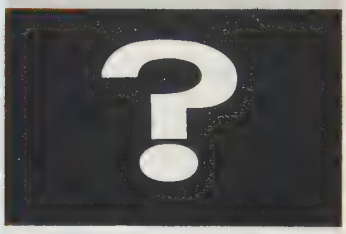

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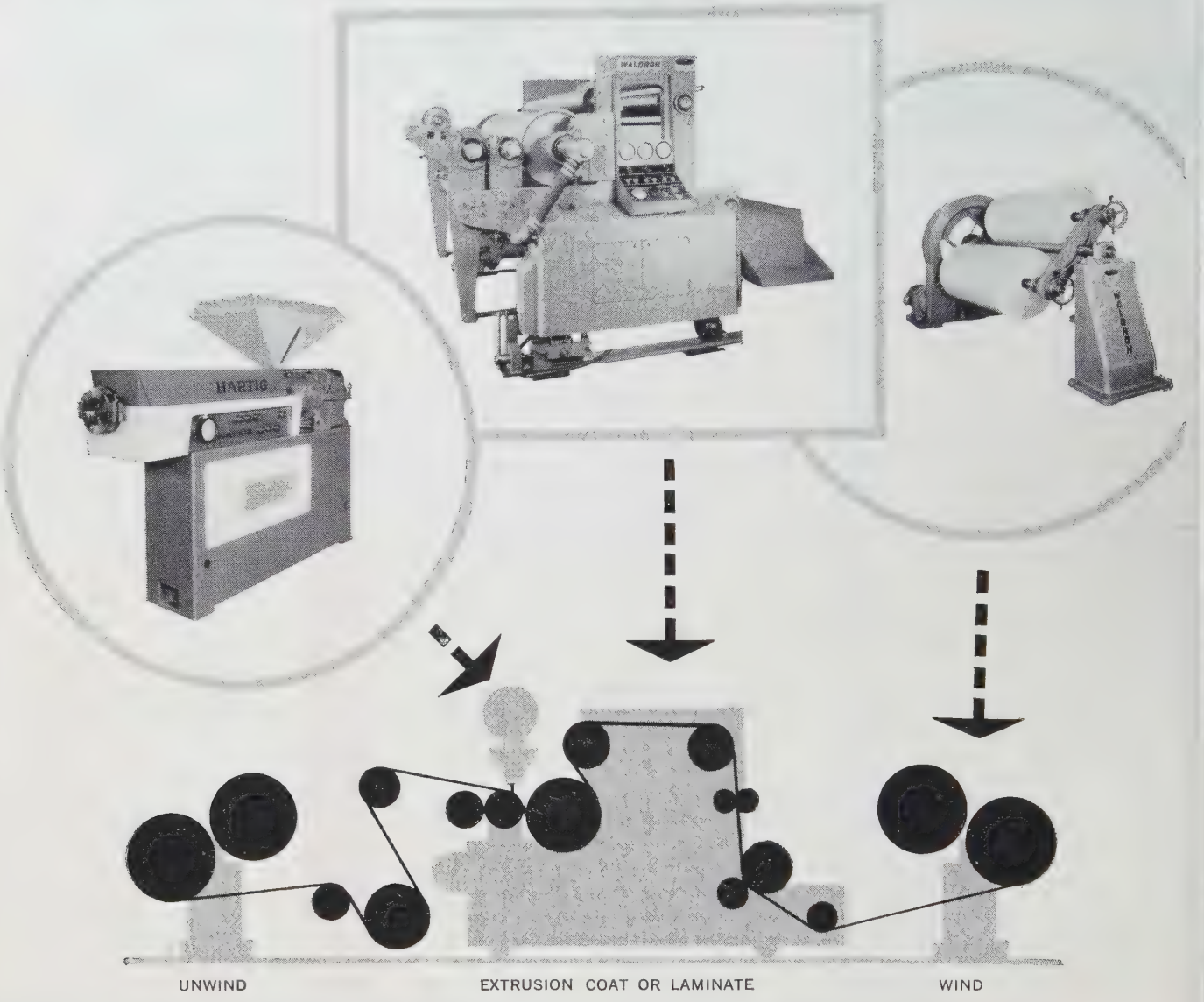

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Changes in Marketing Patterns—Opportunities for Technical Men

BERT CREMERS

For the past six years in addition to marketing, the greater part of my activity has been confined to production, the technical aspects of our business, and management. I thought perhaps the opportunity you have given me here would provide an occasion to talk about the technical man and the salesman and how their activities relate to commerce and industry.

Having been on both sides of this imaginary fence, it is difficult for me to understand why some rather knowledgeable technical people and some very fine sales experts still continue to draw a sharp line between the technical man and the marketing man. First of all, when I talk about marketing, I am talking about industrial marketing in the broadest sense. Today, in our fast-moving, complex business enterprises more and more management people are becoming aware of the fact that changing patterns of distribution offer one of the greatest challenges in the history of our economic times.

Changes in patterns of products, of trade, and methods of bringing the finished product to the consumer have been slow over the centuries, and many times still lag behind the economics and competition which eventually force new methods into accepted practice.

Historians tell us civilizations are judged from three aspects: technical development; social organization; and cultural achievements. No one civilization, we are told, has managed to effect a harmonious balance of all three elements. But outstanding and significant civilizations have excelled in at least one phase or another.

Our present civilization surpasses all previous ones in technical development. In the fields of production, transportation, and communication there is "something new under the sun," the likes of which the world has never seen before.

As businessmen, we play some small part in the unprecedented material and economic advances of our times. And the efficiency and spirit with which we play our parts can be said, without exaggeration, to contribute in some measure to the operation of the most successful economic system so far evolved in the course of world history.

Americans, unlike other people, have a great built-in desire for change, changes in the products they buy, the houses they live in, the clothes they wear, and the cars they drive. We have been accused of being a wasteful nation. This is unfair criticism, because what appears to be waste is merely obsolescence. The great wars in our times have diverted the flow of new goods and at times created a great dam of unfilled wants and needs. In the periods when these unfilled wants were being provided for, the sales people pounded their chests and told the world what a great job they were doing, and the technical people devoted their energies to producing the products and complimented themselves on the tremendous production records they were able to achieve.

Behind this struggle for recognition forward-looking companies were organizing their top technical talent and research to develop new and better products for the competitive times ahead. With all of these great advances, it does seem that the appreciation of a coordinated technical and marketing approach has not been fully developed. One of the reasons for this, of course, is the shortage of technically trained men. Do you know for instance that:

1. Of all the engineers and scientists that have graduated from college, there have been various reports that between 80 and 90% are still alive today.

2. Of all the money spent on industrial research in the history of this country, over one half has been spent since 1955, and the amount spent last year was almost 20% of the total.

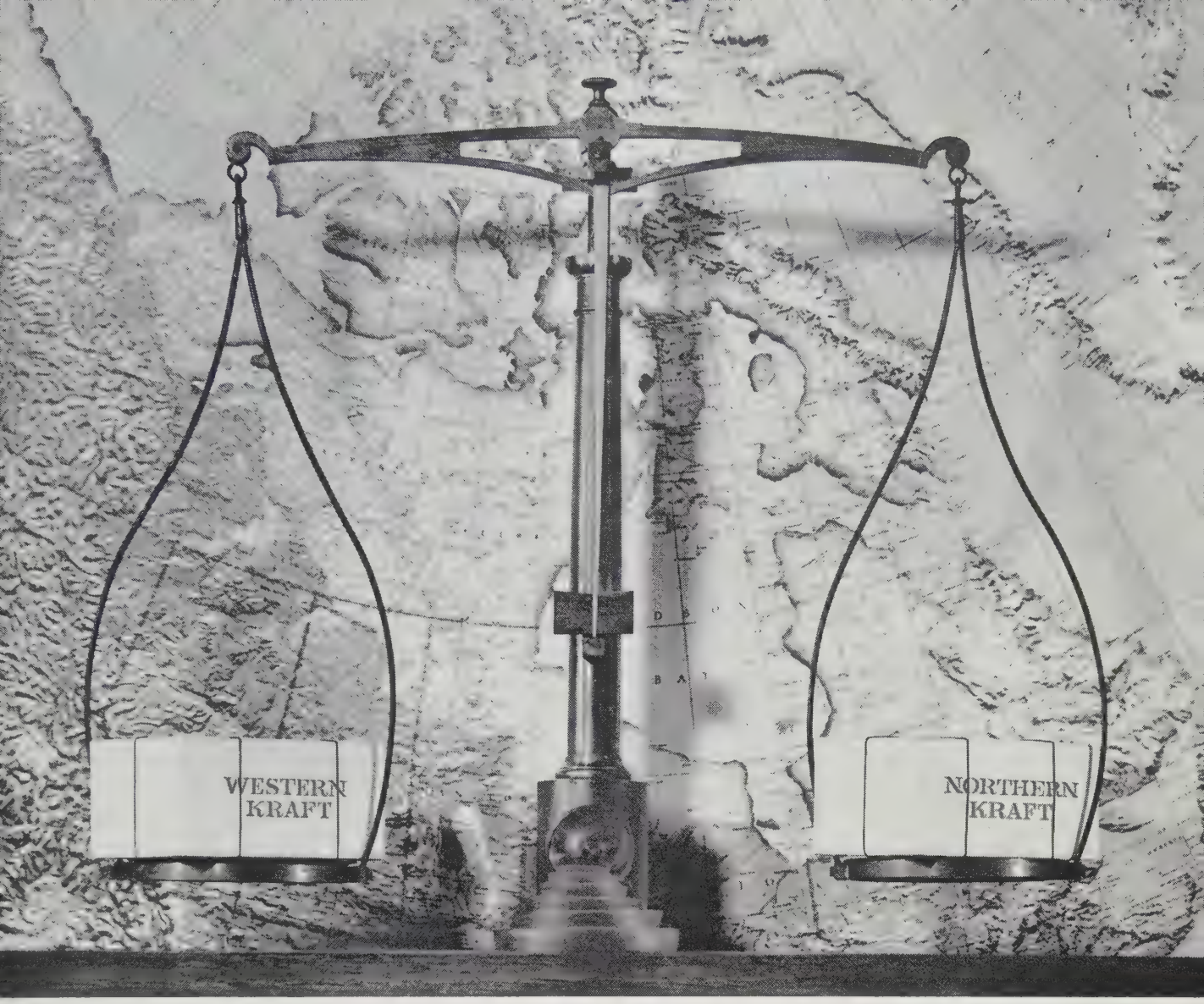
Let me digress for a moment here and comment on something that most of you already know. The paper industry—the industry you represent—is an outstanding example of forward planning. I don't know of an industry anywhere that foresees more dramatic possibilities. Aside from the ever growing demand for the printed page, the world is intrigued with the prospects of the wedding of paper and plastics to form a host of new products from such things as kitchen counter tops, to food containers, to paper for electrical insulation, to disposable clothing and bed sheets.

I don't believe anyone in your industry is naive enough to think these products will automatically roll out of the mills and into the hands of the sales people who will then take them to the market place. The many steps between the early research and development of these products and the final acceptance by the consumer constitutes an excellent example of what is really involved in the ever-increasing complexity of ultimate consumer acceptance and product success.

I am sure that many of your companies have development departments where your technical liaison people bridge the gap between research and sales, or between production and sales. There is a great difference of opinion in the minds of many industrial leaders as to just where market development should fit. Is it part of sales? Is it part of research? Is it part of manufacturing? Is it part of technical service? But wherever it might fall on the organization chart, it is today in our industrial marketing a necessary function to ultimate consumer acceptance, but that in itself is not enough.

Perhaps too many of us still think of the marketer as the old-time salesman. The drummer, the pitch man, the fast talker, and the personality boy has passed out of the American industrial scene along with the

Bert Cremers, Vice-President and Director, Wyandotte Chemicals, Inc., Wyandotte, Mich.



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medicine shows and the covered wagon peddler of a century ago. We took payola out of marketing within the past 20 years to a point where many large companies send out letters during the holidays discouraging even a bottle of Christmas whiskey to their purchasing agents. The recent pledge on the part of a large number of consumer advertisers over radio and television promises to take the subterfuge and outright dishonesty out of advertising and television promotions. More stringent laws are being enacted to prevent misrepresentation.

It is my firm conviction that we are entering into a new morality in our business life which is forcing us to present our products in a different manner. Already you hear a great deal about the new marketing concept, the marketing-oriented company, the multilevel approach. I would like to add to that another adjective which has not been used. I would like to call it the "high fidelity marketing approach." Perhaps the term "technological marketing" would also describe the new function. Whatever we call it, the change is taking place gradually and the new effort is attracting thousands of qualified technical people. And while many of them may still be reluctant to call themselves marketers, they are nevertheless just that.

Does this mean, then, that the sales departments in companies must scrap all of their old beliefs of sales psychology, of a well coordinated presentation, of timing, of placing proper emphasis to arouse interest; does it mean scrapping the ability to be concise, articulate and presentable? Decidedly not. Other things being equal, that is where price, quality, and performance are the same, the technical man who has all these qualities *too* will certainly win out. The practical application of the technological marketing approach, or the high fidelity marketing approach if you want to call it that, is brought out clearly in a case history in my own company.

An important product in our line had served an industry well for many years. It had been handled by technically trained people on our staff. They sensed changes in the consuming industry which might lead to obsolescence of this product. It was difficult to determine exactly what the industry needed and wanted. Now our technical people held a series of symposiums with the research directors in this industry and after many months of evaluation we found out where our product fell down and what specific qualities were needed for the product. Out of this technical approach a new product was developed, demand for which continues to grow month by month. Had we failed to note and act upon the shortened life of the product, brought about by more vigorous competition and rapidly changing markets, and done nothing about it, important sales volume would have been lost.

Not long ago Ted Sharp, director of product marketing at Union Carbide Plastics Co., said that markets don't just happen. I agree with him when he says that management should think of market development in its broadest sense, as removing all bottlenecks to more widespread acceptance of end users. He says and I quote, "The real essence of market development lies in identifying likely markets, analyzing their potential, determining whether it is worth while to develop them more rapidly, and allocating resources to get on with the main job of selecting and selling key end users on the material. Viewed in this light, market development becomes another form of investment with the return being measured in terms of increased sales and profits sooner than would otherwise be realized."

Recently when the National Association of Purchasing Agents met here in Chicago, I was not surprised to hear them come all out for a new marketing approach. A survey confirms, for instance (and this was reported in the March 5 issue of *Chemical Week*) that, and I quote, "Research and the technical aspects of business are enjoying new significance in shaping buying decisions. Reasons for this are enmeshed in the current market picture which often finds few differences among vendors on price, quality, delivery, etc. Looking behind these traditional criteria, purchasing agents lean to the supplier backed by the best research."

Let me read some of the comments these top purchasing people made and which were reported in *Chemical Week:*

Quoting Henry Schoder of General Mills' Chemical Division—"I like to know whether a supplier's technical staff is large and capable, old or young. Younger chaps are more adventuresome, more likely to come up with new ideas and products. I like to look at the quality of technical literature (the tighter the product specifications, the better) and the reputation the supplier has for research in a given field."

Lester Perlman of Morton Chemical Co. thinks a solid research and technical program is evidence that a supplier has a good background in how to handle, store, package, ship, and label its products. He makes a mental note of how fast and how well technical service people come up with the answers. He also pays attention to the quality of technical literature, the impressions he gleans from correspondence; the supplier's letters containing information on a technical problem must be factual, concise, and easy to read.

Chester Teeple, director—purchases, International Minerals & Chemical Corp., thinks that research is undersold by most sales forces, backs this contention with a recent IMC survey. IMC wrote to 27 major suppliers of chemicals, oils, and paper to find out what services these firms offered. Object: to compare these with IMC services to determine where IMC could profitably make improvements. All 27 suppliers mentioned technical service, but only four noted research—clear proof, says Teeple, that research is undersold.

In a later edition on March 19 *Chemical Week* again confirms my viewpoint and points out that in many companies researchers double as part-time salesmen. They cite many instances where researchers contribute their knowledge to advertising, to sales promotion programs and to sales planning meetings. Researchers work with the press to get the product better known in industry by stimulating an initial experimental quantity demand. One company puts it flatly this way: "Where clinching the sale calls for a good deal of technical know-how researchers are often the best salesmen."

There is no question in my mind that a very important change is taking place in marketing in the heavy industries. I suppose what I am really saying is that the future salesman will be technically oriented and

S. R. CHRISTENSEN

Beloit Eastern's John Walsh

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PUMPAGE

Goulds reports on trends in pulp and paper

WASTING POWER AT THE THROTTLE VALVE? When pumps are too big for heads and capacity, power from the oversize motors goes to waste at the throttle valve. Many mills have saved themselves money by using our Bulletin 782.1, *Application Data for pumps handling paper stock suspensions*. Concisely cached between the covers are: 1. Friction curves of paper stock suspensions in pipes, elbows and fittings. 2. Pump selection data. 3. Head-capacity correction. Write for your copy at any time.

PAPER PRODUCTION INCREASED 400% IN 35 YEARS. Production of paper and paperboard reached a new high in this year's first quarter, according to *Paper Trade Journal*. The estimated 8,800,000 tons is only 2% less than the paper produced in all of 1935.

WHEN MOTHER HUBBARD RAN A PAPER MILL. One day she needed an impeller to repair a fan pump. But the cupboard was bare. Mother H. wailed and wept while she watched a series of machines shut down. She made frantic phone calls. She paid the penalty of air freight delivery. We think a mill should never have a bare cupboard. On the other hand, there is no need for it to stock everything. As for us, we try to keep *our* shelves full so we can fill *yours* on short notice.

THE SWITCH STUCK, THE PUMP SEIZED. A capsule tragedy. And it really happened while starting a new pump. They were jogging the motor to check its rotation. Trouble was, they jogged *after* they connected the coupling—and created an adhesive condition. We consider proper methods of starting a new pump so important that we have written a data section on it. In a pump man's language, this section gives fast facts on checking procedures and corrective steps. It also includes valuable information on proper pump foundation and pump alignment. For your copy, just write us asking for Data Section 770.8.

OBSERVATIONS

ON THE RIGHT TIME TO BUY A NEW PUMP

By Phil Olmstead, Chief Engineer, Goulds Pumps

If your *needs* have changed since you installed your present pump, if *efficiency points* have changed because deposits have built up in your piping, if your present pump is *frequently under repair*—chances are, you need a new pump.

That's a pretty good rule of thumb—but you can actually *calculate* your need for a new pump in the dollars-and-cents saving it will yield.

All you do is apply a simple formula to find the horsepower saved by installing a new pump. From this figure you derive your saving in kilowatt-hours. One of our application engineers will gladly work out this formula with you. Then you can easily discover how much a new pump would save you over a year's time.

The most economical pump you can put on *any* job is the one that fits your present needs best.

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GOULDS PUMPS

the future technical man will be sales oriented. If I were to create a composite, then the 60–40 blend as it exists in this room would probably be a good starting formula for the industrial marketer of the future. I see this blend in the ideal marketer as containing 60% technical ability and 40% sales ability; 60% of the cold, hard facts, slide-rule approach, and 40% enthusiasm, open minded and broader approach; 60% of the ability to be able to present straightforward facts and let the buyer arrive at his own conclusion in a natural and orderly manner, and 40% of the ability to know when to ask for the order; 60% of the ability to be conservative in dress, personal habits and manner, and 40% of the fresh, alert and snappy appearance of the salesman; 60% of the ability to detail plans and organize the proper approach and 40% of the intuition and the ability to be in the right place at the right time.

So you can see, out of this group I have tried to construct the kind of an individual who will fit best into the marketing scheme of the future. Certainly no industry has a greater opportunity than the industry with which you gentlemen are associated. The paper industry does not have to look for the pot at the end of the rainbow, because they know they are standing right smack in the middle of one. Merging our technical men into our marketing atmosphere will enable us to set new goals for the future.

Certainly no one can be complacent and no one can say that our goals will not continue to change. Reaching them will depend on how well we fit our organization into the many areas and new frontiers in distribution patterns still awaiting discovery. Tomorrow, as in the past, the most successful businesses will be those companies who are oriented to the new marketing concept. Borrowing a quotation credited to A. M. Whitehead, I would like to close and I quote, "The art of progress is to preserve order amid change and to preserve change amid order."

Presented at the Eleventh Coating Conference of the Technical Association of the Pulp and Paper Industry, held in Chicago, Ill., May 23–25, 1960.

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Research and the Paper Industry

ERNST MAHLER

It is a very real pleasure for me to be with you today. I feel quite at home because it is my understanding that approximately one-half of you are from industry and the other half from the world of education, and during the past fifty years or so, I have spent most of my time in either one or both of these environments. As a matter of fact, a great deal of my energy has been spent in an effort to bring about a closer working relationship between these two most important segments of our society—a relationship which is based upon the proposition that both education and industry are concerned with teaching and the impartation of knowledge; and both education and industry also have the responsibility of improving our understanding of mankind and the universe in which we live.

A few years ago someone asked me what I was going to talk about on a certain occasion. I replied that I really had only one speech or one message, and that message involves the importance of men and ideas, both to industry and to our society. Men who are properly educated. Men who have the ability to think creatively and with audacity. Men who have been stimulated to put their ideas to work. Men of integrity. Men who regard their careers as worth while and exciting. Men who look to the future with hope and expectation. In short, my various speeches have usually been concerned with education or research, or with both. It seems to me that if I understand this conference properly, your deliberations during these next two days are going to be concerned essentially with these matters. And certainly they are matters which have received unusual attention within the past year or so throughout this country.

The striking thing about our national concern with science and education during the past several months is the emphasis upon national security, or national defense. As a result, both education and research have been very much under fire, and many people have overemphasized the quantitative aspects and paid too little attention to the qualitative aspects of our educational and research enterprises. I am sure that we need more education and more research, but I am even more sure that we need *better* education and *better* research. The quantitative side of this picture can undoubtedly be improved through the appropriation of more funds. The qualitative side, however, requires serious thought on the part of all concerned—serious thought, if I may say so, by the kind of people who are attending this symposium.

It has been my great good fortune to spend most of my career in the pulp and paper industry. I say this has been my good fortune for many reasons. First, I have been impressed by the character of the people who comprise this industry. I have been impressed with the essentiality or the importance of the products which we are making. I have been impressed by the vitality of our industry and the fact, for example, that in spite of its age, it continues to be one of the major growth industries. And I have been *especially* impressed by the many opportunities which this industry offers for creativeness and for the practice of stewardship.

The paper industry works primarily with what the chemists would call a "large molecule." We are based on the use of a fiber which replenishes itself and which is a part of the essential rhythm of the universe. The plants which supply us with our fiber cleanse the air by their use of carbon dioxide, and with the aid of sunlight and rain produce and reproduce themselves. This opportunity of creation and re-creation is one of the unique features of our industry. One might go so far as to say that, from a philosophical viewpoint, it imposes many of the same responsibilities and opportunities of stewardship, of self generation, of self discipline, and of unlimited creativity which are so deeply involved in the field of education itself.

I am reminded of a talk which Dr. Lee DuBridge gave a few years ago in Appleton, Wis. At one point he was speculating about the long range supply of some of our basic materials, such as copper, iron, coal, and oil. He was concerned also with our long range supply of energy because as our deposits of these various materials are depleted, we shall have to use an increasing amount of energy to extract them from the earth's surface. Dr. DuBridge referred to three primary sources of energy, first, the burning of carbon or hydrogen-containing materials such as coal and oil; second, use of atomic energy; and third, the use of sunlight. He concluded that as the years go by, sunlight, or the direct use of solar energy, will become more and more important.

Although these speculations do not seriously confront us today and probably will not seriously confront our children's children, it is highly interesting to observe that the pulp and paper industry is based primarily on solar energy, in one form or another. I like very much the idea of being associated with an industry which has such opportunities to grow and to contribute to future welfare.

The processes of research are necessarily painstaking, frequently frustrating and often expensive as we strive for greater knowledge of the materials with which we work and greater insight into the processes we employ. Yet it is principally from this search for knowledge and understanding that the more significant discoveries result.

Several years ago Professor Ihde of the University of Wisconsin presented a paper on "The Inevitability of Scientific Discovery." He noted that many of our significant discoveries and inventions have been made almost simultaneously and independently by workers

Ernest Mahler, Director, Kimberly-Clark Corp., Neemah, Wis.

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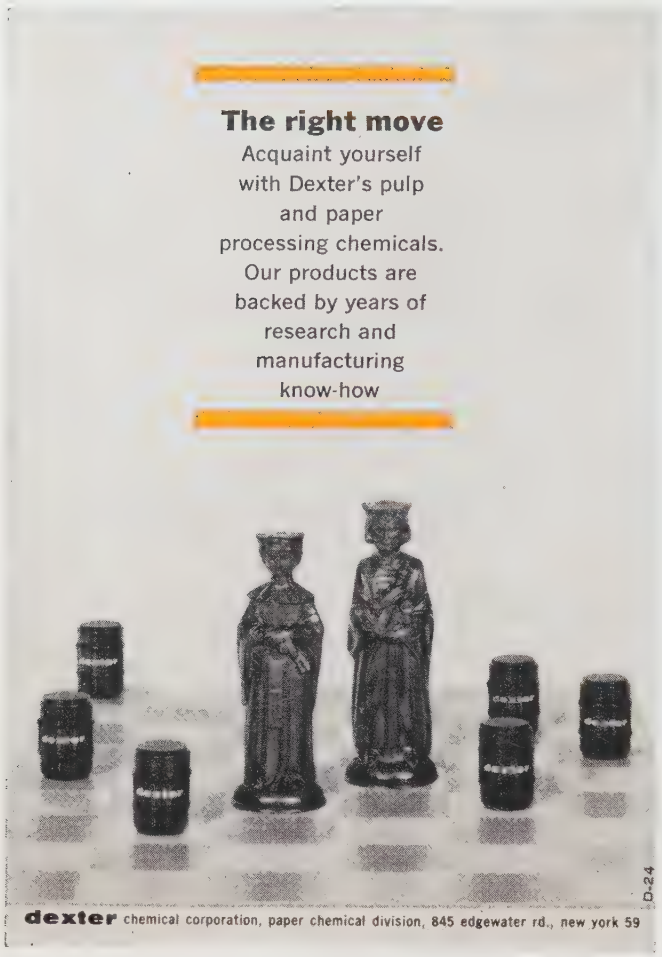

who lived in different parts of the world and had no communications with each other. For example, there are several possible inventors of the telescope; calculus originated quite independently with both Liebnitz and Newton; Darwin and Alfred Wallace independently developed the theory of evolution; and the telephone was discovered almost simultaneously by Bell and Gray. This led Professor Ihde to suggest the hypothesis that "when the time is ripe a certain discovery becomes inevitable." He then examines three possible answers to the obvious question: "What constitutes ripeness?"

One possible answer is based on the idea that necessity is the mother of invention. This answer is rejected because, as Dr. Ihde says, "necessity can only direct attention toward problems that require solution but cannot bring about their solution if certain other things are lacking."

The second possible answer is based on the appearance of some great genius with the necessary insight. This answer is also discarded for at least two reasons: first, many great discoveries have been made simultaneously and second, "the record is filled with names of those who have made only a single important discovery."

The theory of extreme brilliance would suggest that they should have made further contributions if genius alone were the only factor of invention.

The third possible answer is the one which Professor Ihde feels is the most acceptable. He concludes "that the primary factor in bringing about scientific discovery is *not* necessity, *not* individual genius, but the relentless pressure of accumulating knowledge. Seldom is it possible to foresee all those factors that are essential to the solution of a problem until they have accumulatively become a part of scientific heritage. Once the accumulation is complete, the next step becomes inevitable."

I would be inclined to place a little more importance on the factors of necessity and brilliance, and I believe that there might have been some consideration of the part which pure chance plays in many discoveries. It does seem to me, however, that Professor Ihde is essentially correct in emphasizing the accumulation of knowledge and insight.

These are very busy days, and when 75 people converge on Highland Park from all parts of the country one assumes that they do so because they have something in common. In my rambling remarks about education, industry, and the nature of research, I have been trying to find the common denominator of this meeting. It seems to me that, among the things which we have in common is a very genuine interest in and a dedication to the accumulation of knowledge and insight.

Those of you who are in education are, in my judgment, doing a magnificant job in pushing forward the frontiers of science. Many of you, however, have been overwhelmed with problems requiring inmediate solution. Some of these problems have come to you as a result of our national defense effort. Some have come from industry, and still others have been generated within the educational system itself. Those of us who are in industry have likewise found ourselves overwhelmed with current situations, or with what the research director calls "fire department activities."

None of us can escape the problems of the day, and the responsibility which we may have in their solution. It is incumbent upon all of us, however, to think beyond these immediate situations and problems and to see how we can help each other in our mutual concern with fundamental understanding. Although the responsibilities of education and industry cannot be sharply separated, it seems logical that industry's primary concern is with technology and the problems of production, and that education's primary concern is with the expansion of the frontiers of our basic understanding of universal laws and behavior. As this conference proceeds, I hope that the men from this industry will be able to convey to you who are from education some of our scientific problems, and that you who are from education, on the other hand, will be able to convey to the industry people some of your hopes and aspirations, and fundamental concerns. If we can, in other words, excite each other's interest and curiosity this conference will have been worth while.

As a valuable by-product, I would hope that you gentlemen will form more than a passing acquaintance and that you will continue to communicate with each other in order that we may be of increasing help to you in your work, and you in turn may be a constant inspiration to us.

Presented at the American Paper and Pulp Association Committee on Coordination of Research—Fall Research Conference, held at Highland Park, Ill., Oct. 3–4, 1958.

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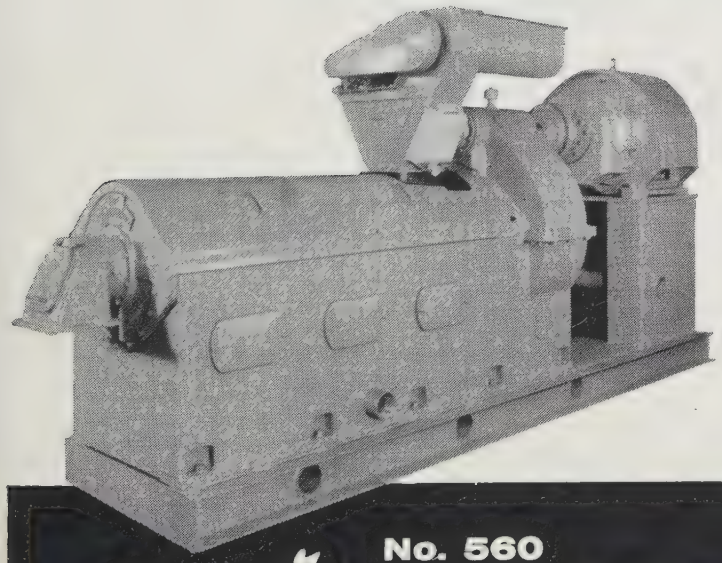

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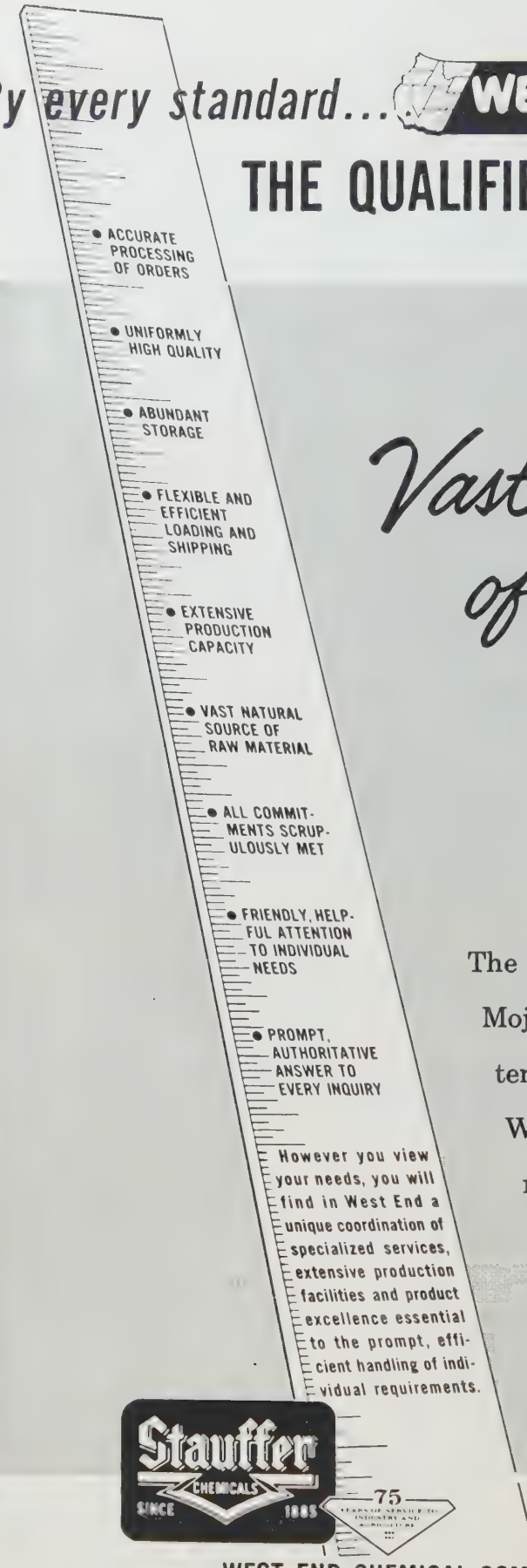
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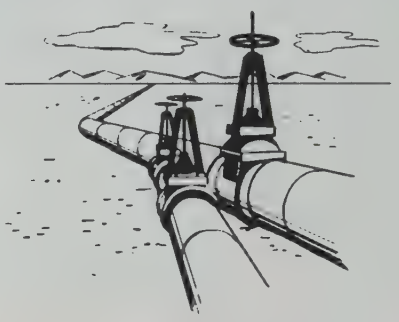

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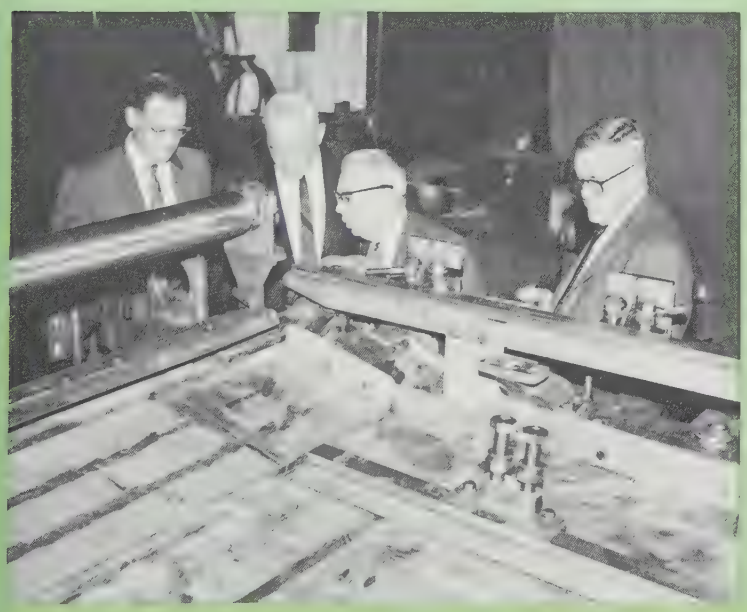
The Beloit Album

SOUTHERN LAND TIMBER AND PULP Corporation's exec. vice president, Edward L. Cowan *(second left)*, at a recent Beloit conference, discusses design details with Beloit's C. E. Macklem, E. H. Neese, Jr., E. D. Beachler, and D. R. Schamp.

(Left) **INTERNATIONAL PAPER COMPANY'S** Mobile Mill assistant UME, T. S. Bartley *(l)* is seen on the erecting floor with Beloit designer D. E. Leavitt. They are discussing a roll wrapper.



(Above) **DUNN PAPER COMPANY'S** president, G. C. Dunn *(r, c)* and mill manager, W. E. Woods *(l, c)*, look over their new Fourdrinier with Beloit's sales manager, F. G. Ramsden *(r)*, and staff engineer M. M. Cobb.

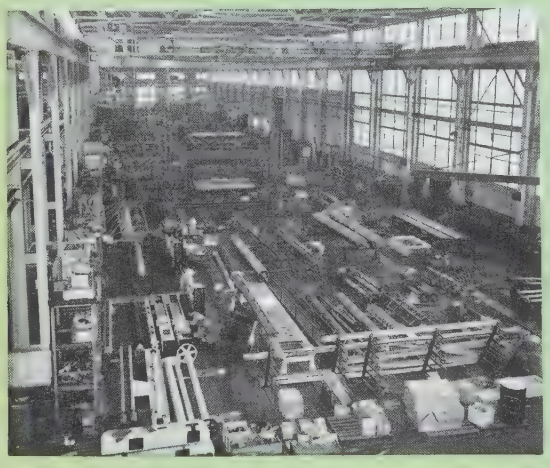
(Right) **CONTINENTAL CAN COMPANY'S** C. S. Huestis *(l)* and Beloit division sales manager, C. H. Swartz, get a close-up view of a vat inlet on the main erecting floor.

Progress report from the Beloit Group

. . . expanding to serve you better

BELOIT EASTERN CORPORATION, Downingtown, Pennsylvania, reveals some dramatic changes since its recent expansion program. Total plant area is now 300,000 sq ft. Building pictured above, at left, houses the expanded foundry and core room. This addition also houses a completely new and modern welding department. Beloit Eastern's foundry now has sufficient productive capacity to meet the needs of its own shops, as well as the casting requirements of E. D. Jones Corporation. Expanded sales and engineering activity further increase Beloit Eastern's effectiveness in the field of finished product processing equipment. Views at Beloit Eastern are seen below. (a) Main erecting area bustles with activity as finished product processing equipment nears completion. Shipping area in foreground will move into new building later this year. (b) Model M Winder nears completion on the main erecting floor. Winder is equipped with Beloit's new improved slitting arrangement. (c) Engineering department where designs for finished product processing equipment begin. Engineering and sales departments share these spacious quarters.

a.



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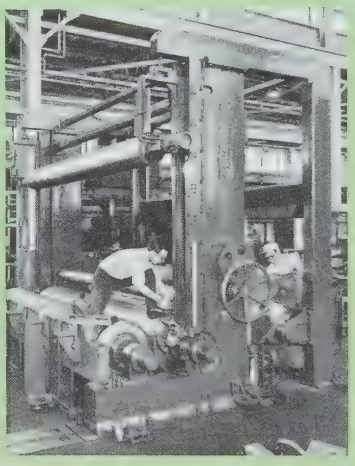
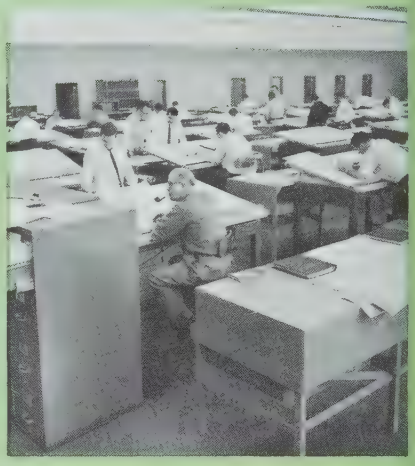
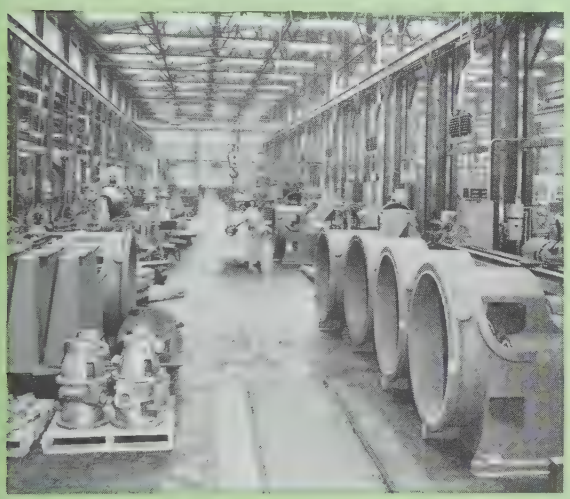


c.

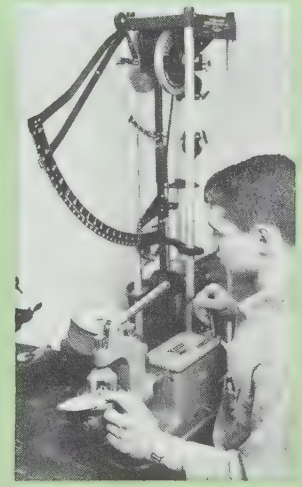


(Below) **BELOIT IRON WORKS, WELDING DIVISION,** is located three miles south of main plant, near Rockton, Illinois. New facilities, embracing the welding and fabricating division in an area of 75,000 sq ft, enable Beloit to offer a new and comprehensive range of fabricating services. This site is ideally located, with direct rail siding, a mile's drive from the Northwest Tollway. View below, with pipe storage in foreground, shows plant shortly after completion. Beloit's expansion plans also include a new 45,000 sq ft Research and Development Center.

E. D. JONES CORPORATION, Pittsfield, Massachusetts, occupies this modern plant, built for utmost efficiency in the design and manufacture of precision pulp and stock preparation equipment. Aluminized steel is the basic building material. The plant covers an area of 200,000 square feet and can be expanded easily to 640,000 square feet. It is functionally modern in every respect, both office and production areas featuring the latest in facilities. The production area is lighted by high output fluorescent lamps and is heated by radiant gas unit heaters, each with integral thermostat. Air conditioned, well-lighted offices are designed to give complete working comfort and efficiency. Plant has complete rail and truck shipping-receiving facilities. Switch tracks lead to main line of New York Central.



ACTIVITY AT JONES is evident in this long-range view of one of the seven manufacturing bays, each 50 wide by 300 feet long. Extensive line of pulp and stock preparation equipment is produced.



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S. R. CHRISTENSEN

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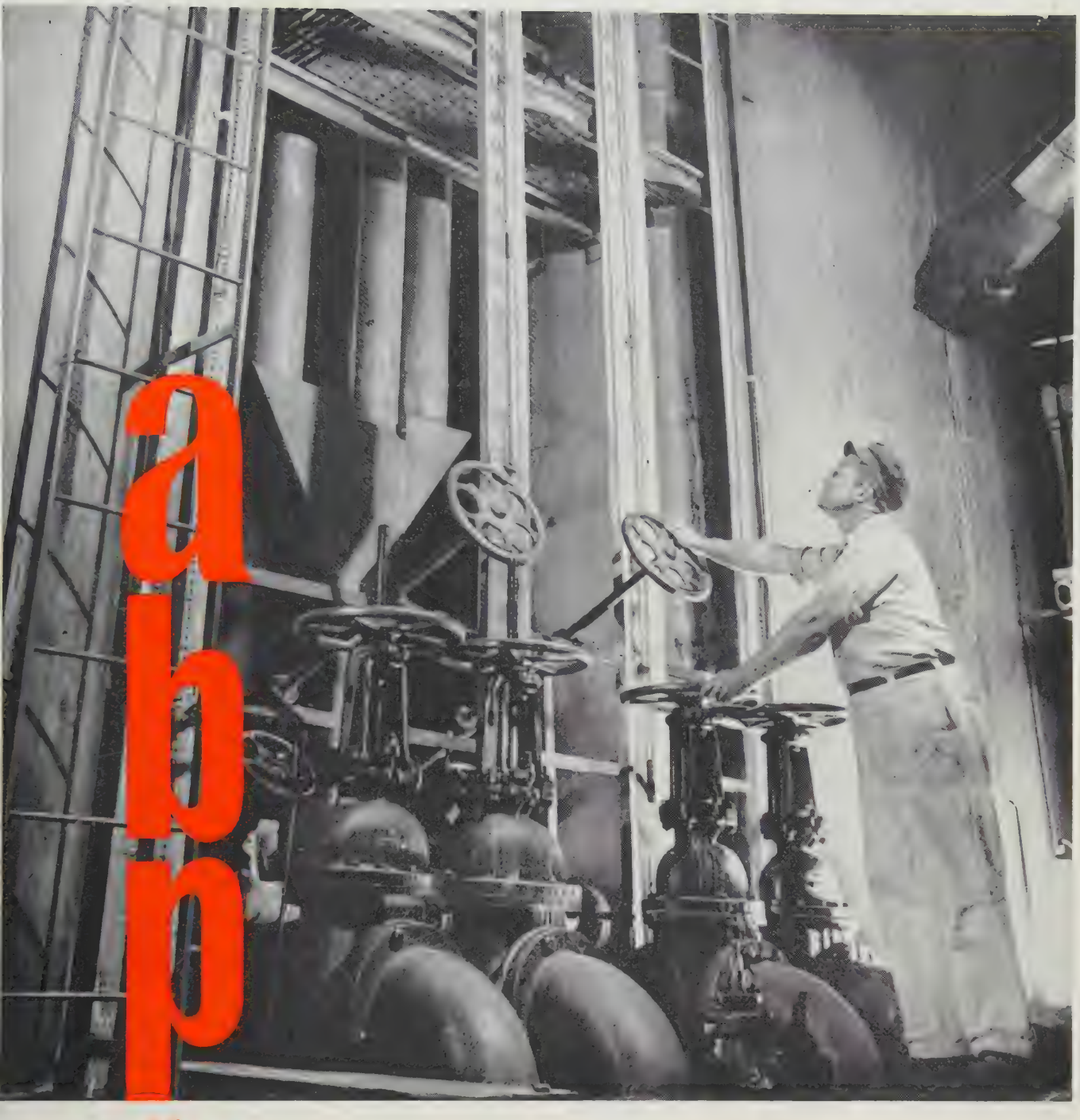

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New Developments in Lithography

MICHAEL H. BRUNO

The lithographic process imposes certain restrictions on the paper that is used. A number of developments have helped to relax these restrictions and make it possible for some lithographers to use letterpress papers. Very important ones have been the improvements in plates which have made it possible to print with much less water. New developments under investigation now show promise of narrowing the gap between letterpress and offset coated papers still further. These are (1) the Dahlgren dampening system, which allows the use of softer inks and even less water, and (2) a new disposable blanket which appears to be more compressible than conventional rubber blankets and prints with less slur. Other developments to eliminate paper complaints include studies at the Lithographic Technical Foundation and other laboratories of ink transfer and tinting and the effect of paper on color reproduction, quality, and quality control.

LITHOGRAPHY has been the fastest growing process in the graphic arts for many years. There are many reasons for this but the two main ones are: (1) the lithographic process is versatile and generally less costly than letter press or gravure; and (2) lithography has had an organized research and educational program since 1925 that has kept the process abreast of the demands made on the graphic arts by advertisers and other users of printing.

In spite of its phenomenal growth and the many improvements that have been made in lithography, it now has the most extensive research program in its history. This is because there are still a few limitations left in the process that can deter its further expansion and growth, if not eliminated. Research is in progress on these and as they are gradually eliminated, new trends show up in the industry.

One serious limitation of the lithographic process which is getting attention now is the need for a special paper which is purer, stronger, and more water resistant than letterpress paper. Research on the whole process is gradually helping to eliminate this limitation and a prominent trend in the industry now is the use of letterpress papers by many lithographers. A number of web offset and some sheet fed printers are using them and enjoying the benefits of cheaper papers designed for letterpress. Why this is possible can be explained by first looking into the restrictions the lithographic process imposes on the paper, and then showing how recent developments in the process have helped to relax some of them.

LIMITATIONS OF THE LITHOGRAPHIC PROCESS

The lithographic process has four properties which impose major restrictions on the paper (*1*): (1) the paper must be pure and its surface must not be excessively water sensitive; (2) tacky inks must be used; (3) if improper packing is used the pressure of printing causes the blanket to slide in the impression on smooth stocks causing slur; and (4) overall contact of the blanket with the paper in the impression nip can cause distortion, misregister, and wrinkling.

MICHAEL H. BRUNO, Research Director, Lithographic Technical Foundation, Chicago, Ill.

Water Sensitivity

Lithographic printing plates are planographic and depend on chemical treatments to maintain the difference between the ink receptive image areas and water receptive nonimage areas. Because of this, the fountain water on the press usually contains chemicals like gum arabic, phosphates, nitrates, and bichromates to help maintain a big difference between ink and water receptivity of the image and nonimage areas, respectively, during printing. Some of the fountain solution gets onto the blanket and comes in contact with the paper. If there are any soluble materials in the paper surface or coating they can be transferred to the blanket at the interface and eventually get onto the plate or into the ink. If these materials can react with the plate or ink, trouble can follow with scum or blinding of the plate, or tinting due to emulsification of the ink. The fountain solution can also transfer to the paper surface. If it is water sensitive, the surface size or coating can be loosened so fibers lift or coating piles on successive units of multicolor presses. If the coating has slow water absorption the fountain solution can remain on the surface long enough to interfere with transfer of ink on successive units of multicolor presses.

Pick Strength

Because the offset lithographic process calls for a double split of the ink from the plate to the blanket to the paper, a much thinner ink film is transferred to the paper. These thinner ink films develop higher separation or tack forces. This means that papers for offset must be made stronger so that they can resist these splitting forces.

Slur

The use of the rubber blanket to offset the impression from the plate to the paper has been cited as a distinct advantage of offset lithography. It allows printing on rough stocks and compensates for moderate variations in paper surfaces and caliper. On smooth stocks, however, the rubber has a tendency to slide in the impression and cause the defect known as slur if improper packing is used. The reason for this is that rubber is not truly compressible. Under the pressure of excessive impression it does not compress like paper, but flows especially in inked areas where the vehicle in the ink acts as a lubricant. This allows the blanket to slide causing an elongation or slurring of the printed elements.

Overall Contact of Blanket and Paper

A serious limitation of the lithographic process is the overall contact of the blanket with the paper. Be-

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cause of this overall contact in the impression nip the paper must be perfectly flat or it will distort in the impression. If it is excessively buckled, the buckles will contact the inked blanket before the impression and cause doubling of the image elements. If it is wavy edged, the paper will "fan in" at the back edges, and if the waviness is serious enough, it can cause wrinkles from about the center of the sheet to the back edge. If the paper is tight edged it will cause the image at the back edge of the sheet to "fan out," and when bad enough will cause wrinkles through the center of the sheet from about one-third the distance back from the gripper to about the same distance from the back edge.

DEVELOPMENTS TO RELIEVE LIMITATIONS

Many of the developments in the lithographic process have helped to relieve the restrictions the process imposes on the paper so that a number of lithographic plants now are actually running on letterpress papers. The improvements to make this possible have been in plates, dampening systems and, most recently blankets, not to mention those that have been made in inks and the papers themselves.

Plates

The most important development in lithography in the past twenty years has been the improvements in plates (*2*). The inconsistency or undependability of plates was the most serious disadvantage of lithography for many years, and kept it from being used for many types of work. Research has changed this situation completely. Now there are many types of good, reliable plates that can be depended upon to print consistently for short runs, medium runs, and even runs into the millions. There are so many of these that the big problem in most plants today is not how to make a good plate but what plates they should use for their type of operation.

There are at least four different presensitized plates which are capable of good quality of reproduction but are good consistently for only short runs up to about 20,000 impressions. There are a number of so-called "wipe-on" processes which use diazo coatings on specially treated aluminum. These plates also produce high quality and, on the average, are capable of longer runs than the presensitized plates. Surface treatments and the new lacquers have resulted in substantial improvements in ordinary surface and deep-etch plates on zinc and aluminum and these are used for runs between 100,000 and 200,000 impressions. LTF has developed a "wipe-on" process for zinc that shows promise of printing good quality reproductions in the range of surface plate runs.

A popular plate is what is referred to as the "copperized aluminum plate." This consists of a deep-etch plate on aluminum in which copper has been deposited on the image areas chemically. This type of plate has been deposited on the image areas chemically. This type of plate has run over 2,000,000 impressions and is used quite consistently on runs up to 500,000 impressions. When made on very fine or brush grained aluminum it is capable of very high quality of reduction.

For the very long runs there are bimetal plates in which the image and nonimage areas consist of different metals that are electroplated. One type of plate, which is usually made from negatives, consists of copper as the image metal electroplated on stainless steel as the nonimage metal. This is the Aller plate. A similar plate has copper plated on aluminum as the nonimage metal and this is known as the Lithengrave plate. The other type of bimetal plate, which is always made from positives, consists of chromium as the nonimage metal plated on copper, the image metal, which, in turn, is plated on zinc, aluminum, or steel as the base metal. These electroplated bimetal plates are capable of high quality of reproduction because they are practically grainless. Also, they can be used for very long runs or reruns because they are very durable and resistant to abrasion.

Abrasion of images can be a serious problem when printing from some papers and especially board. Copper images, preferably electroplated, have shown much better resistance to abrasion than lacquers or other image materials.

The newer plates with finer grains and more water-receptive surfaces require much less water or fountain solution while printing on the press. With these better plates, less water is transferred from the plate to the blanket and then to the paper, so that problems due to water sensitivity of paper coatings are reduced. This one improvement alone has been the major factor in the ability of many lithographic plants to print on letterpress papers.

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Dampening

With the need for less water, dampening on the press has become more critical. The conventional dampening system consists of a water fountain in which a metal or linen covered roller rotates, a cloth (molleton) covered ductor roller, a metal oscillating distributor roller, and two cloth (molleton) covered form rollers in contact with the plate. Many other types of dampening systems have been tried, such as sprays, condensation, etc. (*3*), but none of these has been successful in replacing the conventional system.

The first successful departure from the conventional dampening system came about five years ago with the substitution of parchment paper for the molleton covers on the plate form rollers (*4, 5*). These paper dampeners have been very successful in a number of plants in achieving a better control over dampening than is possible with the conventional dampening system. Even with this system, though, the ink-water balance in critical to adjust and difficult to maintain.

Other methods for dampening that have been tried include the Mullen or Effusor system (*6*). In this method, a large amount of solution is applied to the plate. The excess solution is blown off by an air blade and is drawn off by vacuum. One of the main advantages claimed for it is that dampening is accomplished with so little water that the ink-water balance is re-established very quickly after a press stop, usually in a matter of two to three sheets, and letterpress papers can be printed. The major disadvantages of the system are cost, maintenance, and power requirements.

A promising new approach to the dampening problem is the Dahlgren dampening system (*7*). In this method, the dampening solution consists of about one-fourth alcohol and three-fourths water and is fed directly onto the first ink form roller. This roller does the dampening as well as some of the inking. The advantages claimed for it are (1) ability to dampen with less water; (2) ability to use softer inks; (3) ability to re-establish the ink-water balance quickly on the press; and (4) ease of operating the press by eliminating the need for critical adjustments in the dampening unit. This system is being tried in a number of plants. It is rather expensive but if the advantages claimed for it are valid, they could result in considerable cost savings by (1) making it possible to use letterpress grades of paper; (2) eliminating the need for using waste sheets at each stop of the press; and (3) increasing production by eliminating critical adjustments in the dampening system and relieving the pressman of his anxiety over the ink-water balance.

The Dahlgren system is probably not the ultimate answer to press dampening. It has shown interesting results and several modifications of the system are now being developed independently.

Blankets

The use of the blanket in offset lithography makes up for moderate variations in surface characteristics and caliper of the paper. The use of the present rubber blankets, however, can result in slurred printing when excessive packing is used due to the fact that rubber is not truly compressible and slides in the impression especially when printing on smooth surfaces like coated papers.

A new disposable blanket known as the Polyfibron blanket has been developed by Dewey and Almy Chemical Co., Cambridge, Mass., which shows promise of eliminating this problem (*8*). This new blanket consists of two parts: (1) a rubber impregnated fabric carcass similar to the ordinary blanket; and (2) a compressible fibrous top member coated with a rubber composition on the surface. Each part is about 0.032 in. thick, or half the thickness of an ordinary blanket. The top member is coated with a pressure sensitive adhesive on the back so it can be attached to the carcass on the press. When damaged it can be readily removed and a new top surface attached to the carcass.

The disposable feature of this blanket is certainly a valuable one, especially from the standpoint of cost of replacement. But, it is not the most important feature of this blanket. The fibrous top member of this blanket is claimed to be more compressible then rubber without increasing pressure unduly. Their data would indicate that better conformability to rough surfaces should be possible with this blanket than with ordinary blankets because greater squeeze between blanket and paper should not result in much higher pressure. This compressibility feature of the Polyfibron blanket may also eliminate slippage or sliding in the impression which can cause slur in printing especially on coated stock. This type of blanket should make it possible to get greater consistency of impression and quality of reproduction in printing on smooth surfaces.

OTHER RESEARCH

The developments in plates, dampening, and blankets have helped to eliminate some of the limitations of the lithographic process and made it possible for letterpress papers to be used for some types of lithographic printing. The limitation of overall contact between the blanket and the paper in the nip of the impression still exists. As far as we know, no research is going on in this area, although some thought has been given to the problem at LTF and some work may be started soon.

Ink Transfer

There is a good deal of other research going on in lithography that can have some bearing on the effect of paper on the process. A number of organizations, as well as LTF, are studying the mechanism of ink transfer (*9*). With a better understanding of the forces involved in the transfer of ink from one surface to another, we should know more about the exact requirements of the paper for optimum transfer of ink.

Tinting

LTF is also studying the problem of tinting. Tinting occurs when ink is emulsified in the fountain water, probably at the interface of ink and fountain water on the plate. A number of factors are involved, all of which are not known. The type of plate, treatment of the blanket, composition of the fountain solution, ink, and other printing conditions are important factors, as is the composition of the surface of the paper. When we know the answer to tinting, we may be well on our way to explaining the still little known mechanism of dampening on which the whole lithographic process is based.

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Color Reproduction

Considerable research has been done on the effect of paper on color reproduction. The absorption of light by the paper has an important effect on the reproduction of halftone tints (*10*). These always appear darker than they should and the finer the screen ruling, the darker they appear. Also, the effect is greater on uncoated papers than on coated papers and varies with different papers.

Another property which has a considerable effect on color reproduction is the color of the paper. This affects the lighter tints where additive mixtures are involved and is most serious when excess fluorescent brighteners are used in the paper. The reason for this is that most brighteners reflect light in the blue region of the spectrum which shifts all light tints toward blue. If neutral brighteners could be found this would not be a problem.

Quality and Quality Control

Perhaps the most important development in research now is the work that is going on to control the quality of reproduction automatically while the press is running. Color and quality control are still serious problems in lithography. LTF has made an exhaustive study of the quality of halftone images and how it can be defined and measured objectively (*11*). The factors affecting quality are (1) interference patterns, like graininess, mottle, moirè, etc.; (2) image definition, such as sharpness and resolution; and (3) tone and color reproduction. A recording densitometer has been built to measure these factors, but it is too slow an instrument to use in production. A print quality instrument is now being designed that will measure these factors at press speeds, can be used for quality control, and eventually can be put directly on the press.

Along with the study of the measurement of the quality factors, a study is also being made of means to control each factor. Once the instrument for measuring these factors is available and means have been developed for controlling them, it should be possible to control the consistency of color and quality of a reproduction automatically on the press; assuming, of course, that the factors lend themselves to mathematical or statistical analysis, and electronic computers can be used. This will mean automation of quality control and elimination of the serious problem of inconsistency in color and quality of reproduction.

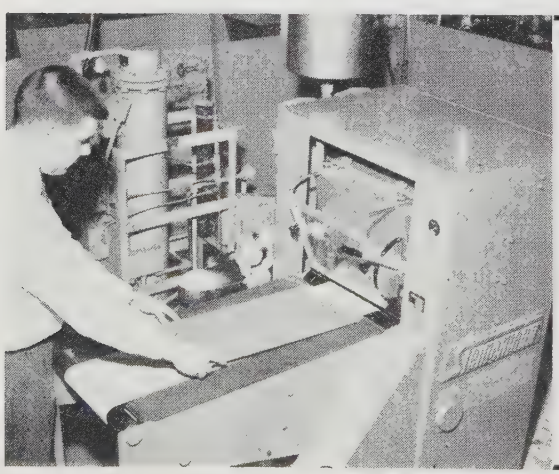
SUMMARY

Many advances have been made in lithography but a few limitations still exist that make it necessary to have special papers for lithography. Developments in plates, dampening, and blankets, as well as those in inks and papers have helped to relax some of the restrictions put on paper, and many plants are now using letterpress papers for some types of work. Research is being done in a number of other areas to control the effects that paper still has on the process. These areas include ink transfer, tinting, color reproduction, and automatic control of color and quality.

REFERENCES

1. A complete discussion of these and other properties of paper is contained in LTF Bulletin No. 308, "What the Lithographer Should Know About Paper," Revised Edition, May, 1959.
2. A complete discussion of lithographic platemaking appears in *The Lithographers Manual*, Vol. 1, 20th Anniversary Edition, Waltwin Publishing Co., New York, 1958, Chapter 10, pp. 10–1 to 10–46.
3. Wood, W. H., "A Review of Dampening Systems for Lithographic Presses," *TAGA Proceedings*, pp. 177–186 (1955).
4. Dowdall, J. F. and Ireland, Frank, "Disposable Dampener Roll Covers," *Modern Lithography*, 23, No. 2: 41–42 (February, 1955).
5. Hubbard, Bruce W., U. S. pat. 2,787,213.
6. Muth, John H., "The Effusor Dampening System," *TAGA Proceedings*, pp. 60–67 (1953).
7. Gegenheimer, Harold W., "What is the Dahlgren Dampener?," *Modern Lithography*, 27, No. 6: 32–33, 143, 145 (June, 1959).
8. Payne, John D., "Fountain Dope," *New England Printer and Lithographer*, 23, No. 1: 31–32 (February, 1960).
9. Borchers, C. H. and Bruno, M. H., "Studies of Ink Transfer in Lithography," International Bulletin, pp. 96–102, June, 1958.
10. Yule, J. A. C., and Nielsen, W. J., "The Penetration of Light Into Paper and Its Effect on Halftone Reproduction," *Proceedings—Third Annual Meeting of TAGA*, pp. 75–76, 1951.
11. Jorgensen, Geo. W., "Quality of Lithographic Images," Part I, Research Progress No. 34, October, 1955; Part II, Research Progress No. 36, July, 1956, Lithographic Technical Foundation, New York.

Presented at the Eleventh Coating Conference of the Technical Association of the Pulp and Paper Industry, held in Chicago, Ill., May 23, 1960.



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The Company's engineers wanted to avoid, if possible, the high cost and space requirements of the customary two washers, with repulping between wash stages, and still maintain a low dilution factor of 3.

For this application, Eimco designed and built the 8-ft. diameter by 10-ft. low submergence pulp washer shown above. Several carefully calculated modifications were made in the filter's hydraulic system to accommodate the liquor volume for two stage washing needed for 97% plus removals on one washer. Special valving was installed for the fast separation of wash fluid and strong liquor, and for recycling weak wash liquor.

From start-up, the unit exceeded its design specifications. Washing efficiency has been uniformly high. Low submergence design results in rapid displacement of wash fluids by air at cycle speeds of 0.7 - 1.0 RPM. There has been no corrosion of Fourdrinier wire.

Modern Eimco equipment for pulp washing, water treatment, filtration, wastes removal, recausticization has helped to save processing dollars in many pulp and paper operations. Your nearby Eimco representative may be able to show you how you can reduce costs, with Eimco equipment.

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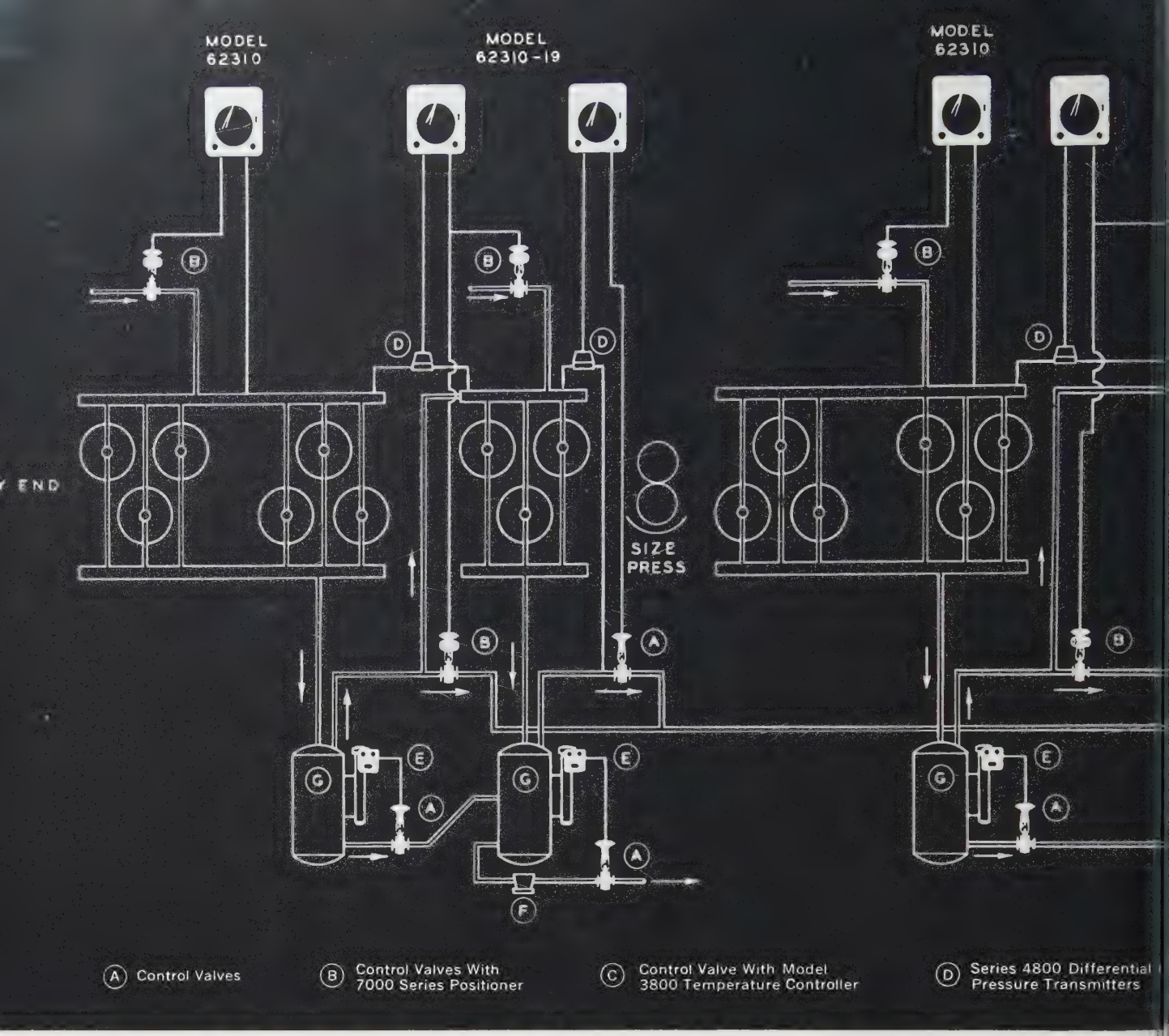
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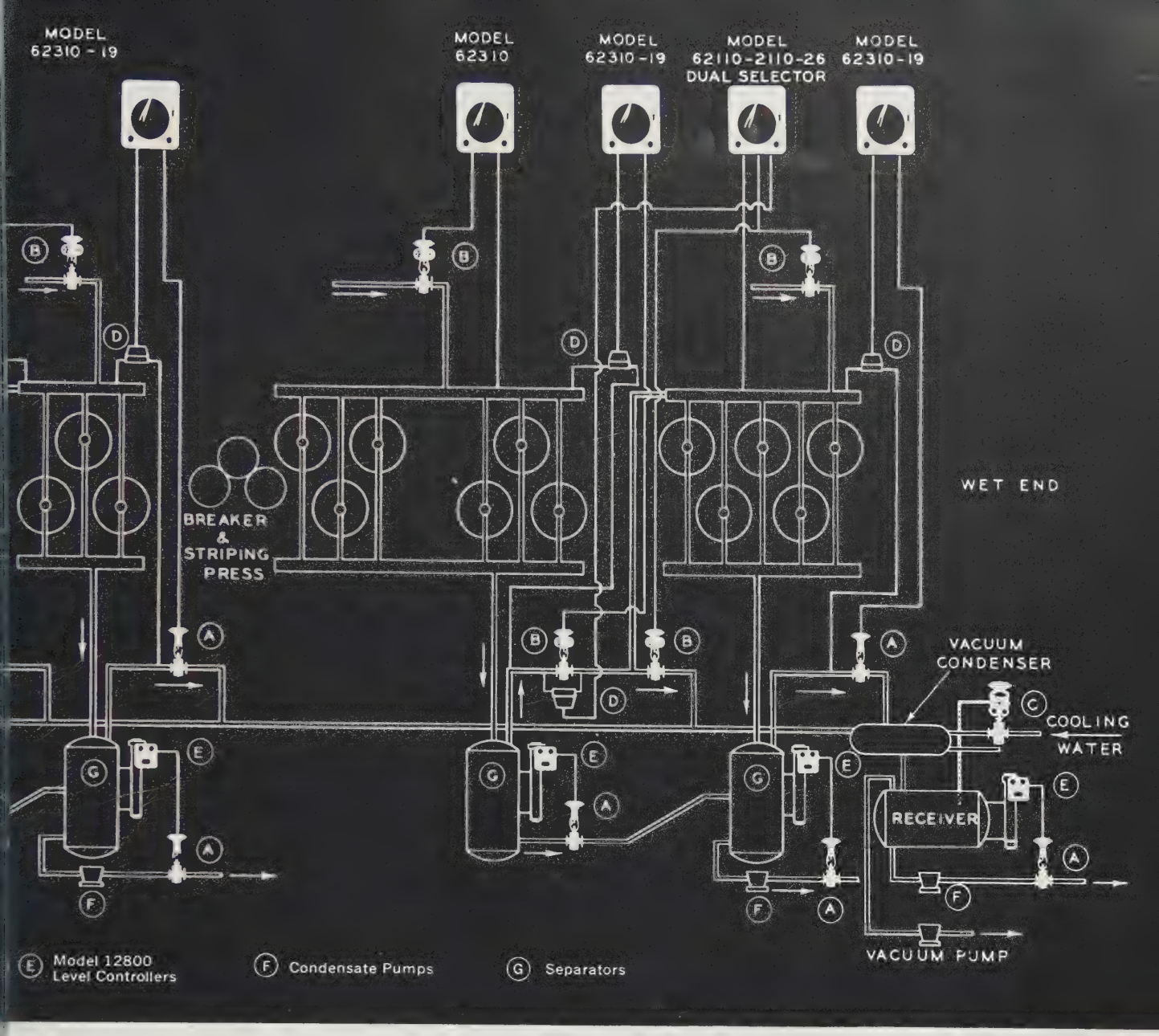

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These systems are available for Single and Multiple Section Paper Machines and for Yankee Driers, including Warm-up Control and Automatic Surface Temperature Control. Mason-Neilan engineers the systems and furnishes all equipment and controls — one source and undivided responsibility — for both new and rebuilt machines.

Send for Bulletin PD 113 . . .

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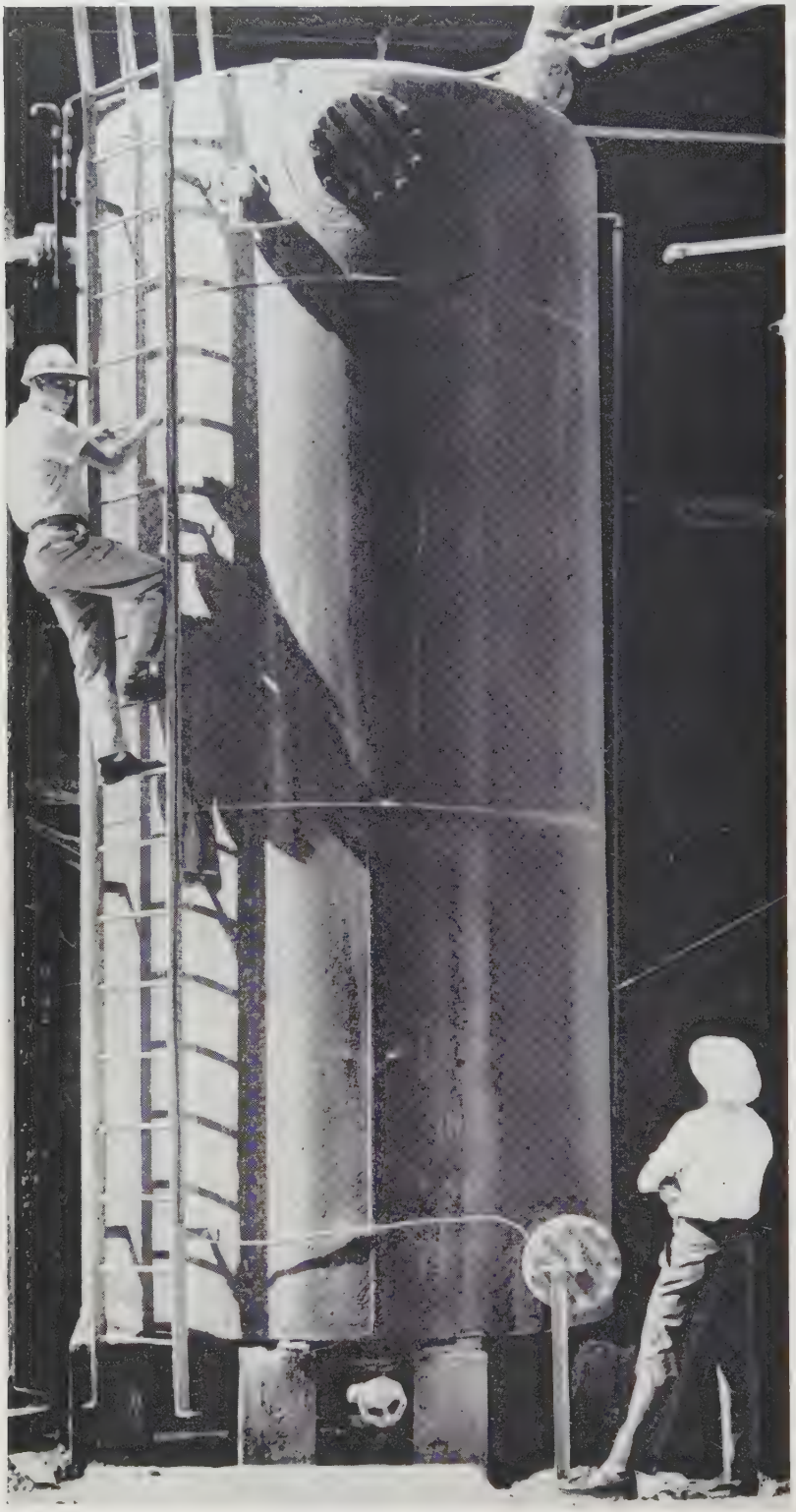
Inconel alloy stops clogging in blow condenser



Clogging of tubes stopped. Substitution of Inconel alloy for carbon steel in the tubes of this blow condenser stopped clogging. Inconel alloy has shown outstanding resistance to attack by black liquor and to chloride ion stress corrosion cracking.
Photo courtesy of Champion Paper and Fibre Company

No clogging...No appreciable attack by black liquor or chlorides.

Every 20 minutes this condenser takes a blow from one of 9 digesters at the Pasadena, Texas plant of Champion Paper and Fibre Company.

When made of mild steel, the condenser tubes had to be cleaned a number of times a year. Corrosion of the tubes provided a rough surface where insoluble organic matter could attach and rapidly clog them. And the tubes lasted 24 months at most.

Still no clogging of Inconel alloy tubes

When Champion installed Inconel* nickel-chromium alloy tubes early in 1958, the results were quite spectacular. There has been no clogging of condenser tubes to date. The splendid corrosion resistance of Inconel alloy provides a smooth surface where insoluble organic matter cannot readily adhere.

These Inconel alloy tubes show no significant corrosion on either side. On the shell side, they withstand slightly alkaline vapors at 230°F and 5-10 psig. Vapors contain sodium hydroxide, hydrogen sulfide, sodium sulfate, sodium sulfide, turpentine, methyl mercaptan, and dimethyl sulfide. On the water side, 75 ppm of chlorides and 8.3 ppm of oxygen have caused no trouble.

To select the right materials for your pulp and paper application

To help solve your corrosion, sliming, contamination or wear problems, we maintain a large file of technical data. Write to us now for information on any metal problem you may now have, or anticipate.

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The table-size model pictured here is really a *complete* wax-coating machine. With this and our other lab equipment, Atlantic technicians can match conditions you'll encounter when you're coating paper stock with paraffin for any commercial purpose. This is possible because every factor present in wax-coating operations also is present and can be carefully controlled on these ingenious testing devices.

First, Atlantic researchers check the wax temperature, paper speed and chilling bath to make sure they agree exactly with the information you've furnished our Sales Engineer. Then they determine by informed experimentation the proper waxes required for seal strength, moisture resistance, blocking, slipping or whatever characteristics are necessary to solve a specific paraffin coating problem.

This paper-coating machine is typical of the testing equipment used in the Atlantic Research Department to assist you in serving your customers. Others include our exclusive Imflex Tester for determining impact resistance and flexibility . . . the Seal Strength Tester which measures the force-per-inch necessary to separate wax paper laminations and seals . . . and tests for gloss, resistance to grease and for finding the coefficient of friction on waxed surfaces.

Your Atlantic Sales Engineer will be happy to assist you in solving your wax-coating problems. His years of specialized experience should prove invaluable in helping you select the paraffin blends best suited for your own requirements. And his on-the-spot technical assistance is backed by the complete facilities of the Atlantic Research Department.

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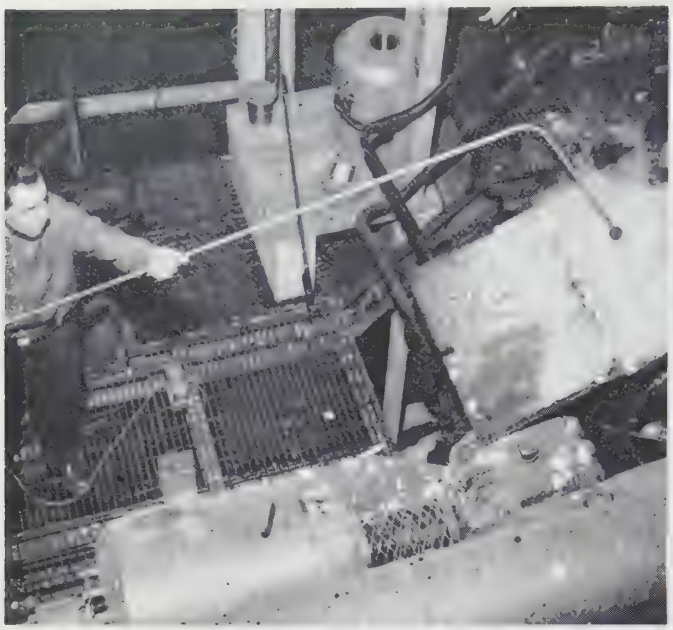


Actual tests begin by adding radioactive plastic "chips" at chip feeder. Here, a single "chip" is held by vacuum tool.

"Chips" are timed as they enter the top of one of St. Regis' Kamyr continuous digesters.

Thermocouple recorder develops a complete record of temperatures at key points throughout digester.

When "chips" finally reach bottom of digester, crews are alerted to quickly recover them.

Now! St. Regis nuclear research probes

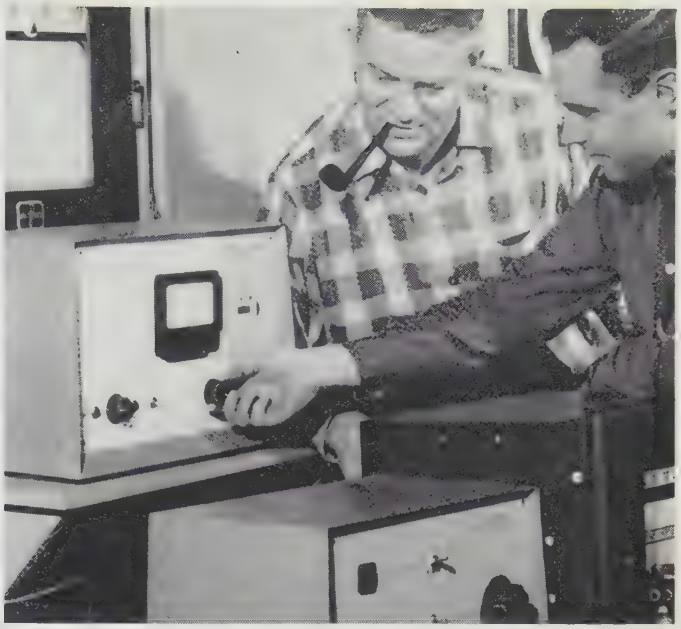
"What actually goes on inside the thick, windowless, steel walls of continuous pulp digesters?"—that's an extremely complex question the pulp industry has never been able to answer completely.

Now St. Regis® better understands the answer—thanks to recent nuclear research studies performed by the Commercial Products Division of Atomic Energy of Canada, Ltd. Conducted by these top Canadian nuclear scientists, the unique research project used thermocouples and nearly a hundred Geiger counters to blanket the huge Kamyr continuous digesters which produce Alberta Hi-Brite pulp.

Then radioactive oxide of Lanthanum-140 was encapsulated into special plastic containers that looked like ordinary poker chips. Lanthanum-140 oxide was selected as the tracer because it had adequate strength to penetrate the thick digester walls . . . and because its radioactive charge lasts a relatively short time.

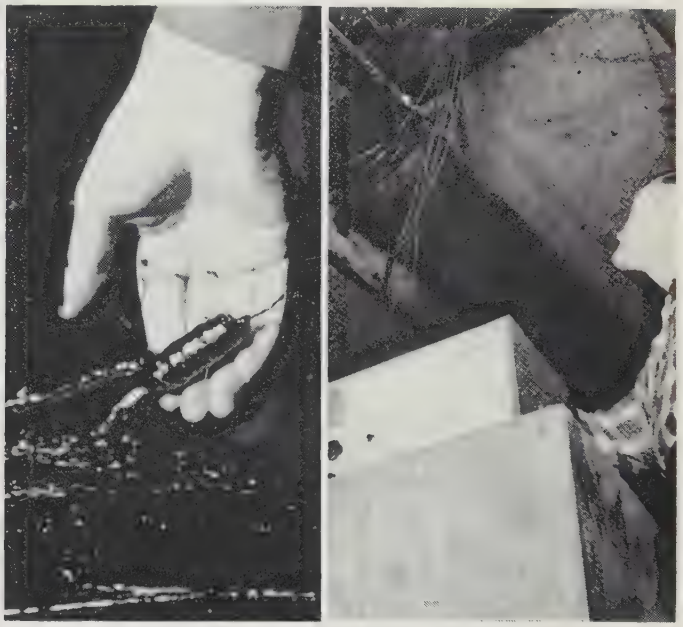
These hot "chips" were fed into the normal chip flow one at a time. Each chip's course was traced by Geiger

Path of every "chip" is carefully traced throughout digester. Here, a hot "chip" is located near top of the digester.



This automatic Geiger counting system traces the path of each "chip" through digester.

"Chips" are recovered with hand tools as they reach the Jonsson knotters, then returned to lead-lined storage vessels for safekeeping.



For added safety, "chip" reclaim alarm systems were spotted along knot conveyor and pipe to black stock storage tank. *Every* hot "chip" was recovered throughout test.

the "hidden secrets" of pulp digesters!

counters and recorded with special electronic systems. At the same time, thermocouples developed temperature data that could be correlated with path of chips.

While the actual on-site research work took just under five days, months of advance preparations were required; in addition, it will take many more months to fully analyze and interpret the data gathered. Armed with this new data, Hinton Mill personnel expect to control the cooking of the Kraft Pulp more closely than has ever before been possible in commercial operation.

The only such research project in North America, this is one more example of St. Regis' continuing effort to improve what many say is the world's finest pulp.

Get the full story on Alberta Hi-Brite Bleached Sulphate Pulp and the advantages it offers you. St. Regis Paper Company, 150 East 42nd St., New York 17, N. Y.

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Economical Cellolube Q-2 treats tissue stock for as little as $1.33 per ton, and toweling for $3.30 per ton. Increased processing speeds may actually lower your over-all costs! Tanatex is prepared to demonstrate Cellolube Q-2 in your mill on a full scale trial. For details write, wire, phone:

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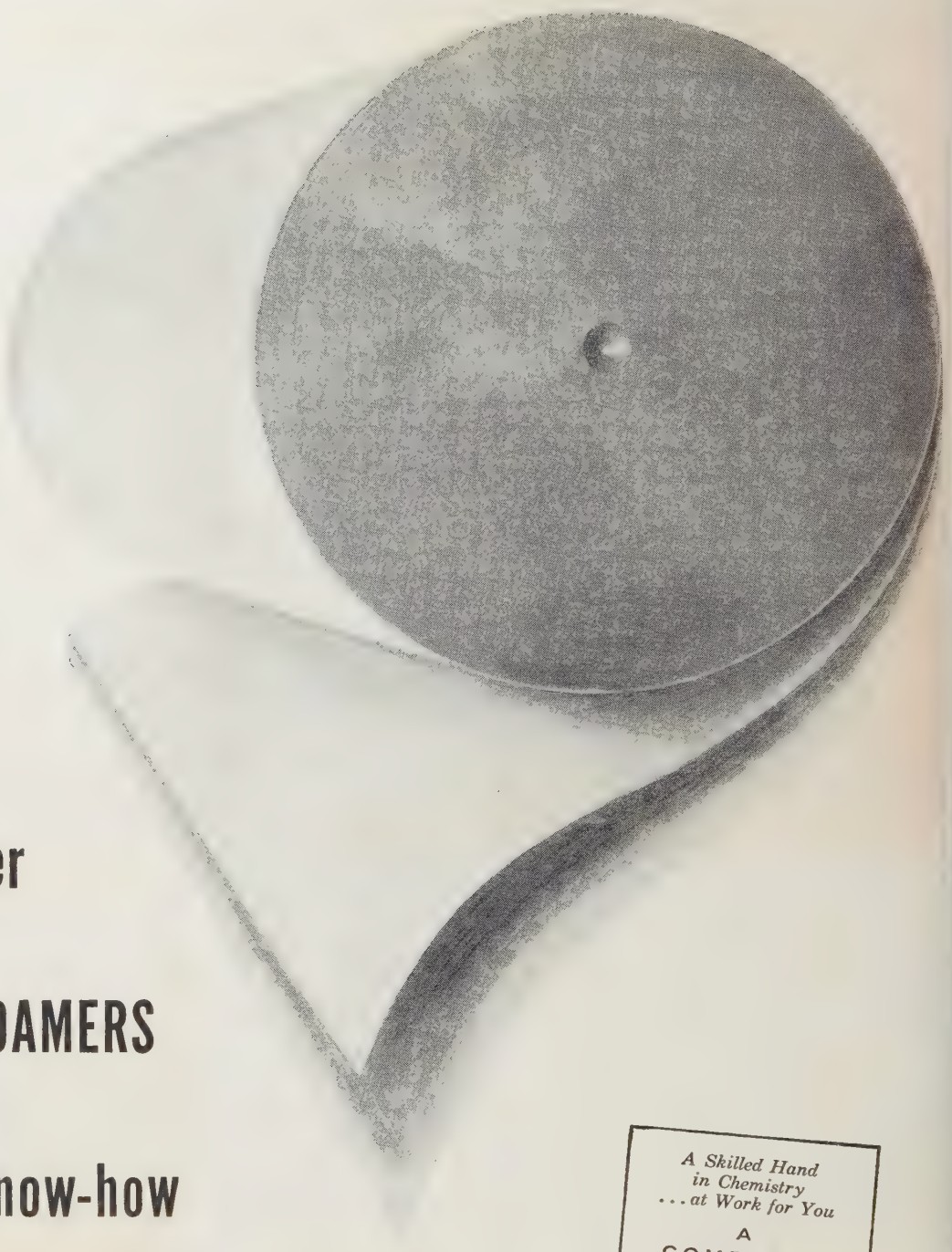

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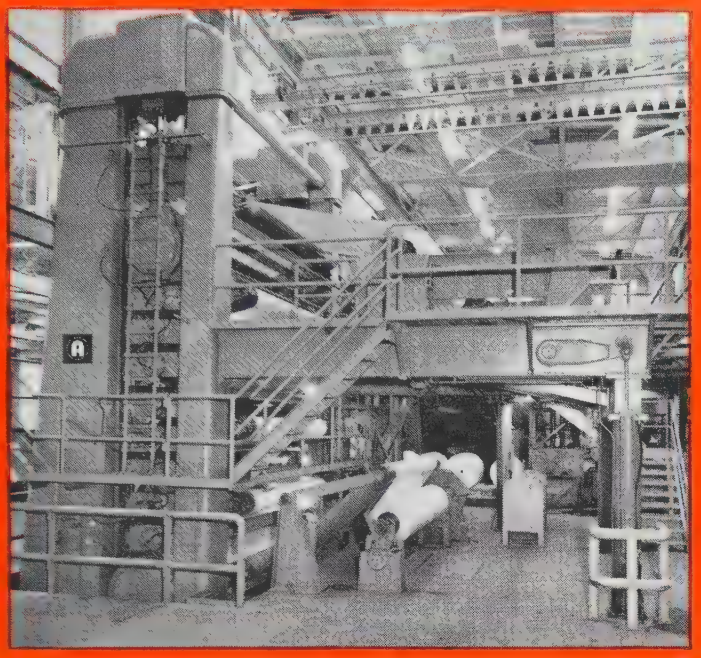

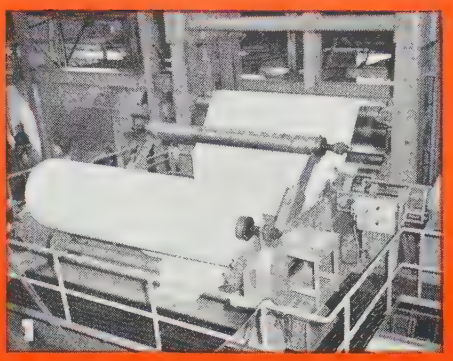

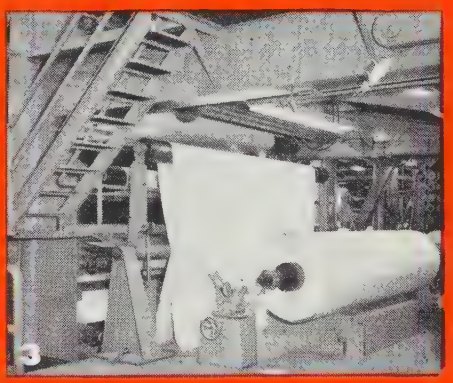

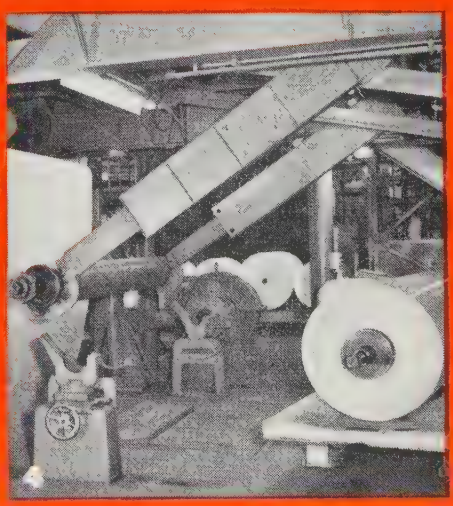

Appleton's push-button, automatically sequenced, Unwind and Windup is designed for efficiency . . . and *delivers* just that!

Illustrations show the Mead Corporation, Chillicothe Division, installation of this newest of Unwind and Windup units on an Appleton supercalender.

Sequence photographs portray how: (1) Arms raise spool from unwind bearings and return to horizontal "park" position. (2) Parent roll is mechanically conveyed on dollies into unwind position. Spool is clamped in place pneumatically. (3) Wound roll is removed from windup stands by tilt top elevator. (4) Spool is lowered into windup bearing saddles. Arms automatically retract to "park."

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A Proposal for Advancing Science in Marketing

T. B. McCABE, JR.

You are very gracious to invite me to speak here at your luncheon today. You have given me a wonderful opportunity to outline an idea which should be of mutual interest to most of you and would contribute materially, I believe, to a further evolution of the concept of marketing which the American Marketing Association has done so much to nurture and develop over the past 25 years.

I am sure you would agree that marketing today as a major force in industry is facing the greatest challenge in its history. In order to meet this challenge, our companies individually and the economy collectively will need sharper marketing tools and more intelligently trained marketing personnel if we are to fully capitalize on the national and international marketing opportunities at hand.

As a science, marketing has not kept up with advances in the area of technology in other areas. The whole process of creating demand for goods and services and distributing these goods in line with reasonable profit objectives has not been fully evolved or exploited. And each year the problems and opportunities became ever more complex, particularly when we find ourselves operating on virtually a world-wide basis.

In this connection, I would like to chat with you briefly about an idea which the president of our company has proposed and which we at Scott are anxious to see developed and are willing to contribute toward that end. An idea which we feel can materially contribute to an improvement in the science of marketing. An idea which will need the intellectual and economic support of all of you ladies and gentlemen here in this room if it is to be fully realized. And an idea which we feel should contribute materially to the sales and profit growth of the majority of industry and the economy as a whole.

Basically, we feel that there is a substantial need for the immediate establishment of an institute that would be dedicated to the task of developing improved technology in the area of marketing and boosting standards of marketing education at the graduate level.

Nationally the need is great. Most companies of any stature in our economy, be they regional or national in their operations, manufacturer, wholesaler, or retailer, are going full speed ahead. The sum total of these expansion plans, many of which are represented by you people here in this room, add up to an enormously challenging national objective. In the overall, this visualizes an increase in gross national product from around a 500 billion dollar level in 1960 to approximately a 750 billion dollar level in 1970. And many businesses within this overall figure have growth plans which visualize corporate growth of 100% or better over the next 10 years.

Our national objective visualizes the maintenance of full production, continued high employment, continuing improvement in the standard of living, and greater participation on our part in the economic development of the fringe areas of the world.

And we must accomplish all of this within the framework of a dynamic, highly competitive economic and social environment. For those of us in marketing, this represents a tremendous challenge. Although the orientation of manufacturing companies today is increasingly toward the market and away from production, in the sense that marketing management is providing production and research with direction closely related to marketing requirements, we are still lacking in the area of technique. And as we all know, in any competitive segment of the market today, the organization with the sharpest techniques and the greater experience in utilizing them will win the game. The ball is in our court in effect, but we have to know what to do with it.

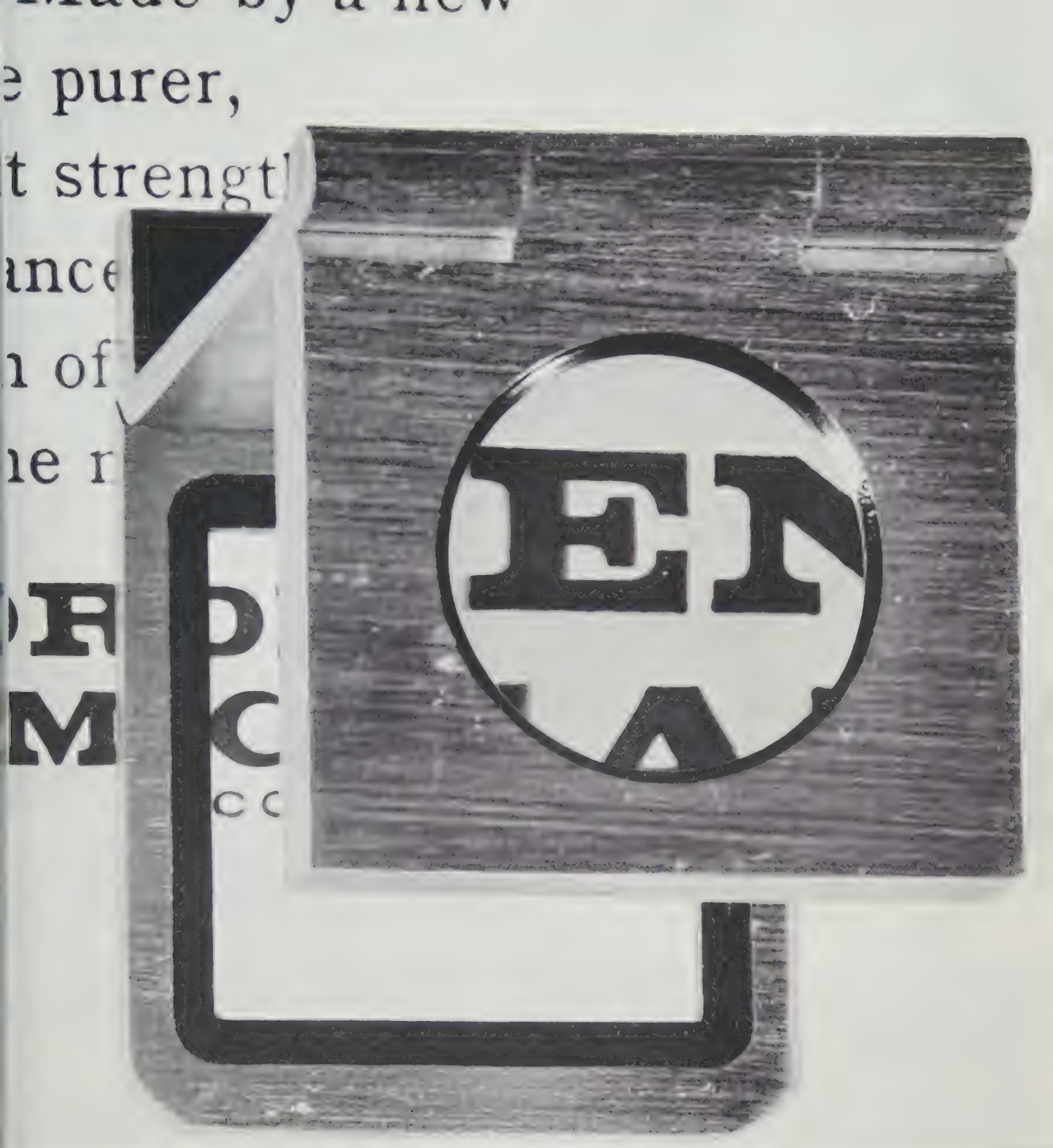
I think an outstanding example of the marketing challenge we face can be found in the area of new product development. Fifty years ago scientific and technological research had hardly begun. Today it is a major force in United States industry and is growing at a very rapid rate. The pressure on us in marketing has just begun.

In 1959, it is estimated that 9 billion dollars was spent on new processes, new products, new technological developments of every kind. Five years ago, the figure was just half this amount, and since it takes an average of six years to develop a new product from a technological point of view, the number of new products that will be thrust on us marketeers to sell in the next few years will be staggering compared with what we have had to accomplish in the past. Unfortunately, our results to date in successfully marketing new products throughout industry have not really been too outstanding. It is estimated that some 6000 new products are introduced each year and only about 500, or 8%, are really successful. The major reason for failure seems to be the lack of sufficient accurate testing prior to launching.

Of course, we all know that test marketing is the final approach to the commercial introduction of a new product. But what is involved in test marketing? How many markets shall be employed? I wonder if we all could agree on the basic principles to be applied in the selection of them. Then there are the many questions to be considered in determining the test methods that are to be used. And probably one of the most critical question is, "When will we have adequate information to make a proper decision?"

This is one great area in which our research techniques must be improved. It is only one of many which, I am sure, face many of you almost every day. Some of you may be thinking this very minute of some problem connected with product development for

T. B. McCabe, Jr., Scott Paper Co., Chester, Pa.



SEEING IS BELIEVING

Printing has more sparkle and snap when your papers are treated with LEMOLS, Borden's new, high-quality polyvinyl alcohols. Made by a new process, Borden's polyvinyl alcohols for papermakers are purer, clearer, and easier to mix. LEMOLS *improve* dry and wet strengths, transparency, gloss, dimensional stability, grease resistance, and increase ink holdout substantially. To improve the finish of your papers, ask a Borden technical representative for a sample of the new LEMOLS. Write The Borden Chemical Company, Polyco-Monomer Department T-80, 350 Madison Ave., New York 17, N. Y.

THE **BORDEN CHEMICAL** COMPANY

©TBC

©THE BORDEN COMPANY

which you would earnestly like a more accurate or dependable testing method.

In many fields of market research there seems to be no real agreement as to the research techniques to use in any given situation. For example, there are several different techniques for measuring the size of television audiences—and at least two ways of measuring the effectiveness of magazine advertising. Scott, like every other large advertiser, uses all forms of national consumer and industrial advertising. But what is the relative sales effectiveness of these various media?

Just about everyone is making some effort toward finding out more about this. I know that considerable progress has been achieved in auditing audiences, measuring advertising awareness and probable influence. But the critical evaluation of return from advertising and promotion effort is a kind of "Holy Grail" that so far has eluded every attempt toward solution.

The standard answer when this question is asked seems to be, "You can't compare apples and oranges." Yet every advertising medium, whatever its nature, has only one function and that is to get a selling message into the minds of consumers and make them act upon it. If each medium has a sales effect, it should be possible to measure that effect. As yet, we do not have the methods for doing this adequately.

One of the primary purposes of such an institute as I propose here would be to provide a "togetherness" and a "singleness of purpose" of all concerned toward the advancement of scientific methodology in the solution of such problems as this.

There are, of course, many other areas for improving our research techniques—sales forecasting, selection and training of salesmen, development of more effective packaging—must to mention a few.

What is required is the development and improvement of basic techniques which we can adapt to our own operations. We are, therefore, proposing that a number of companies and associations join together in the establishment of a marketing institute devoted to this cause. This would be an independent institution staffed by top-flight social scientists and mathematicians. At least in the beginning, as we see it, the institute would be relatively small in size and would devote its energies to a few major top priority projects. The institute would have perhaps a dozen full-time staff members recruited from our great universities and some from industry. The actual research work would be under the direction of a man fully familiar with the current status of technology in marketing research and a man with a compelling interest in the field.

In addition to encouraging and supporting the advancement of marketing technology, the institute would provide another major benefit in the form of assisting toward the improvement of the curricula of universities and colleges in the science of marketing research and salesmanship. Members of university staffs working on specific research projects should develop more thoughtful intellectual concepts which would become a part of the teaching spectrum of their own institutes. Further, we visualize that every effort would be made to transmit findings of the institute to the proper people in educational institutions. They would be encouraged through periodic seminars to make a continuing contribution to the work of the institute and the institute in turn would, hopefully, in a constructive fashion, influence their thinking and that of the students graduating each year. We, in our company, are particularly concerned by the fact that graduating students do not through typical business school programs receive adequate training in technique, nor acquire a sufficient comprehension of marketing fundamentals.

Institutions, of course, have been developed in other fields along somewhat similar lines to the one we have in mind for marketing. The Institute of Paper Chemistry in the field of technical research and the National Bureau of Economic Research in the field of economics are examples. In each case, the institutions are operated largely on an independent basis maintaining close contact with both industry and the academic world.

Of course, in order to be successful, such an institute would require not only the financial support of a wide range of industry, but also the willingness of industry to provide the institute with certain types of research information and also to participate in technological experimentation.

The fundamental findings as developed would be published. Everything published would be available to all business firms just as all medical discoveries are available to the medical profession. If those who support the institute feel that they ought to derive from it special benefits as a result of their support, some of these benefits could be in the form of consultation privileges or access to specific material before publication. Also, the supporting firms would have an opportunity to send qualified men to the institute for special research and study.

The institute, however, would definitely not, in our view, conduct contract research nor be set up in any way as a business enterprise.

Of course, we recognize that progress has been made in the development of advanced marketing education and technology in the past 10 years. A number of universities now offer graduate degrees in marketing at both the masters and doctors levels, but these are primarily teaching schools and are not dedicated to the development of basic techniques in the marketing area. Further, they do not provide the type of extraordinary graduate training in marketing that is essential to meet today's marketing challenge. We visualize that the institute I have outlined would provide this.

Study of the institute would involve actual participation in the development of new marketing techniques in the same way that advanced graduate work is oriented in technical fields. That is why, in the course of much discussion and thought, it has been suggested that the institute be given the name "The Institute for Science in Marketing." At least for a beginning such a name, we believe, would describe an organized effort devoted to the advancement of marketing education and technology. We believe that this is the kind of undertaking which could work hand-in-hand with your own marketing association with a minimum of duplication and a maximum of accomplishment.

The principal question at the moment if you recognize the need for such an institute is where do we go from here? Gordon Hughes and I have addressed ourselves to this problem for the past several weeks. Following a recent meeting with our president and vice-president

Solvay "Miniature Mill" helps customers improve pulps

Handsheet in process of manufacture from customer's pulp sample will be used for testing.

When you submit a pulp sample to Solvay for analysis, it is literally "put through the mill." Its fitness for the product you want to produce is determined in a laboratory mill that duplicates actual production conditions.

Solvay graduate engineers, versed in pulping, bleaching and papermaking, conduct these tests. They employ novel experimental techniques utilizing a wide variety of basic and advanced equipment to produce practical results for the industry. They can recommend the *best bleaching sequence* for a mill without prejudice. Solvay is actively interested in chlorine, chlorine dioxide, hydrogen peroxide and hypochlorite.

Write for information or technical aid in applying any of these bleaching agents or other Solvay® products listed.

Solvay Chemicals For The Paper Industry

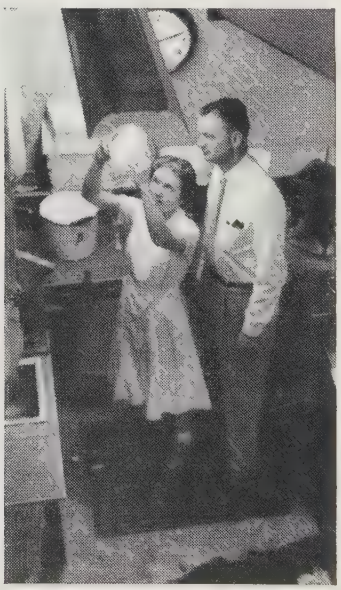
Caustic Soda	Hydrogen Peroxide
Chlorine	Soda Ash

Allied Chemical

SOLVAY PROCESS DIVISION
61 Broadway, New York 6, N. Y.

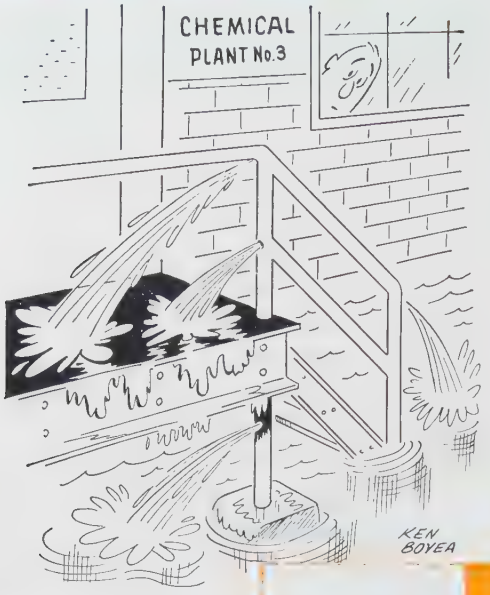
SOLVAY branch offices and dealers are located in major centers from coast to coast. Send export inquiries to Allied Chemical International, 40 Rector St., New York 6, N. Y.

Wood chips (right) are resolved in the digester, then produced into fully bleached pulp (left) for handsheet test.



Inspection of handsheet reveals suitability for physical testing and cleanliness of pulp (presence of foreign dirt or unbleached fiber bundles).

Life in these excited states...

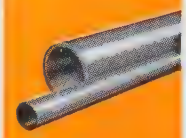


Corrosion is full of surprises

Out-guessing corrosion has been our business for 100 years. We now make 8 types of chemical resistant pipe . . . with valves, pumps, and tanks to match . . . and pretty well know what to expect with them. If anything, our advice is on the *safe* side. Please consult us with *any* problem.

RIVICLOR
for ageless strength

All-purpose rigid PVC. Sched. 40, 80 & 120, ½ to 4". Threaded or socket-weld fittings. Valves ½ to 2". NSF-approved. *Bul. CE-56.*



NEW
ACE Gear Pump

Improved design . . . now 12 gpm. All wetted parts acid-resistant, wear-resistant Ace hard rubber. Finest available. *Bul. CE-55.*

SUPPLEX
tops in economy

Flexible poly pipe, ideal for water lines, drains, underground pipe or conduit. Sizes ½ to 2", long coils, NSF-approved for drinking water. *Bul. CE-57.*

VALVE HEADQUARTERS

World's best chemical valves . . . at moderate prices. All-plastic, rubber-lined, or all-hard-rubber. ⅛" pet cocks to 24" gate valves.

ACE *chemical resistant equipment*
BY **AMERICAN** HARD RUBBER COMPANY
DIVISION OF **AMERACE** CORPORATION
ACE ROAD • BUTLER, N.J.

See ACE equipment in Chemical Engineering Catalog

in charge of marketing, it was agreed that Scott Paper Co. would underwrite the cost of a study to determine the exact nature and scope of the institute.

I am happy to report that an outstanding man from the field of education had agreed to conduct this study—Professor Albert Frey, who taught marketing at the Amos Tuck School, a gentleman who I am sure is well known to all of you. Professor Frey, as you know, is very familiar with all aspects of marketing and has conducted a number of special studies in relation to major marketing questions.

We met with Professor Frey a short time ago and generally discussed plans for the study. His first undertaking will be to select one or more individuals from the academic profession to join with him in this endeavor. He also is considering and beginning to schedule the several aspects of the work to be accomplished toward the completion of a preliminary report by mid-fall of the year.

I am sure you will join with me in wishing Professor Frey every success. From his efforts and later on I hope from the intellectual and economic support of the marketing world which you represent will be born an institution which could contribute so much to our future economic growth and well-being.

Presented at the Annual Conference of the American Marketing Association, held in Minneapolis, Minn., June 16, 1960.

Tenth

Corrugated Containers

Conference

of the

Technical Association

of the

Pulp and Paper Industry

Royal York Hotel

Toronto, Ont.

Oct. 10–13, 1960

New HEAVY DUTY WELDRUM BARKER

BUILT TO BARK MORE WOOD

Faster — Cleaner — At Less Cost Per Cord

The Weldrum Barker is the answer to your ever increasing demands for higher production at the lowest cost per cord. This new barking drum represents 50 years of experience in design, manufacture, and application by Canadian Ingersoll-Rand.

Many satisfied users report high production figures and one user says that he is getting "wood—clean as a whistle".

For specific information and detailed estimates, contact your nearest Ingersoll-Rand Office, or ask for a copy of the booklet "The Weldrum Barker" by writing to Canadian Ingersoll-Rand Co. Limited, Pulp & Paper Division, 620 Cathcart Street, Montreal 1, Canada.

Specialists in Design, Manufacture, and Application of Barking Drums.

OTHER C-I-R PRODUCTS FOR THE PULP AND PAPER INDUSTRY

MOBILE LOG BARKERS
BIRD CENTRISCREEN PRESSURE SCREENS
BIRD CYCLEANS
BIRD VIBROTOR SCREENS
JONSSON KNOTTER SCREENS
HAUG REFINERS AND DRAINERS
HAUG KOLLERMILLS
VICKERY DOCTORS
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DIRTECS
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PUMPS
COMPRESSORS
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C-I-R EXPERIENCE IS YOUR WARRANTY

ST. JOHN'S
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TORONTO
SUDBURY
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IR CANADA

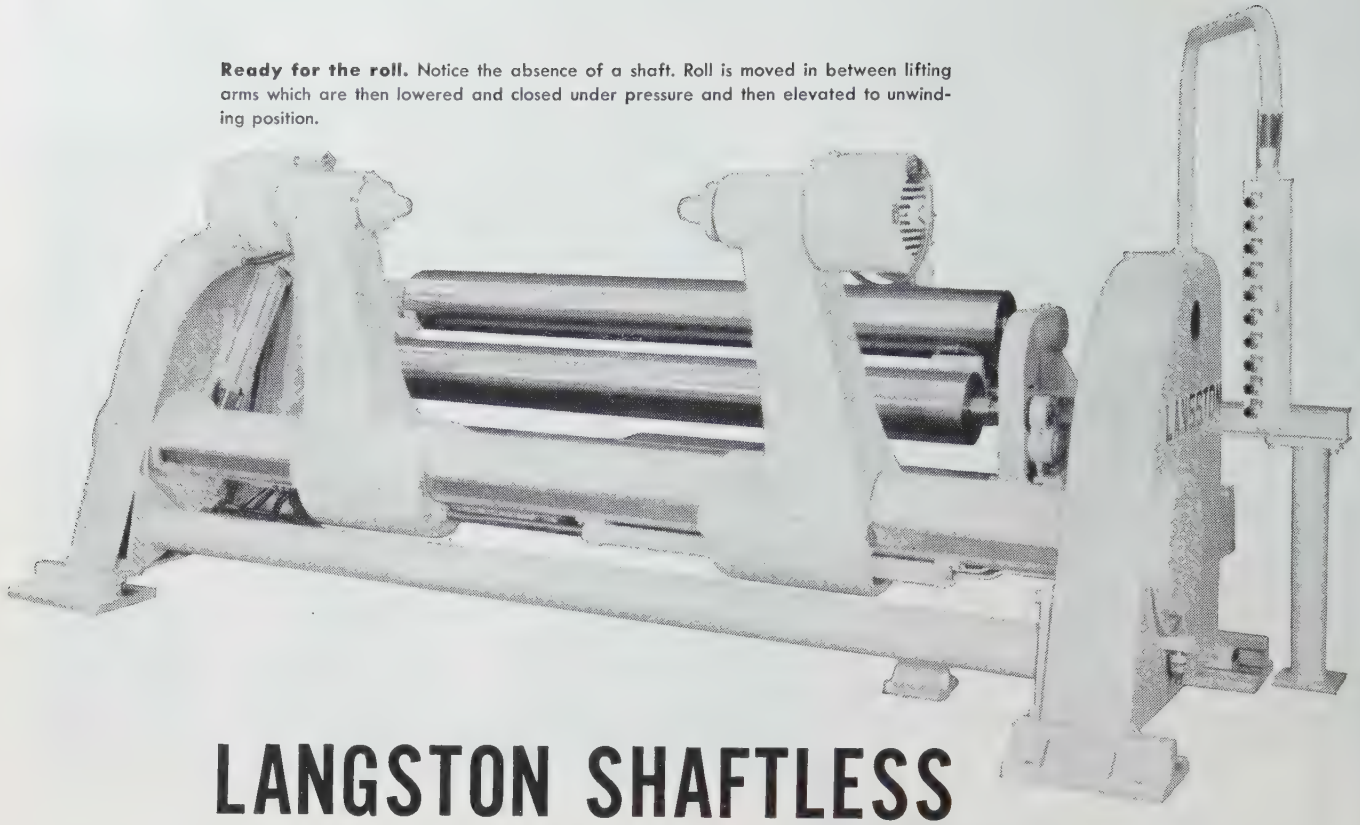
*TRADE MARK REGISTERED

Canadian Ingersoll-Rand Co. Limited

HEAD OFFICE MONTREAL QUE. WORKS SHERBROOKE, QUE.

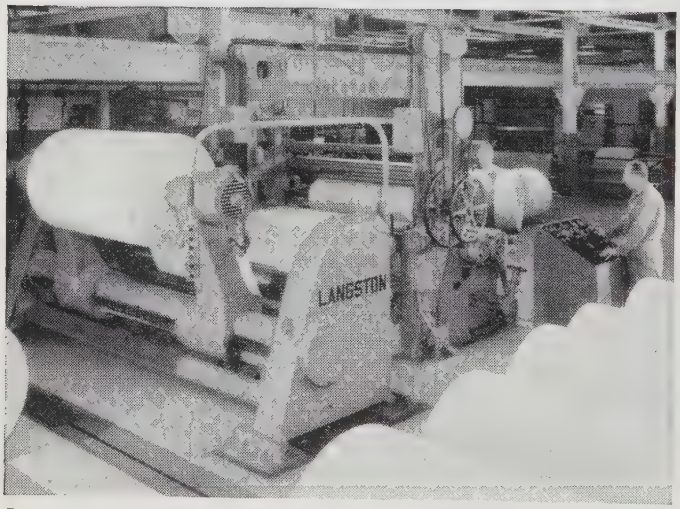
O-129-A

Ready for the roll. Notice the absence of a shaft. Roll is moved in between lifting arms which are then lowered and closed under pressure and then elevated to unwinding position.



LANGSTON SHAFTLESS UNWIND STAND

Boost your production . . . reduce your slitting and rewinding costs



Easy, fast, completely safe. One man does everything. Operating push-button controls, he closes lifting arms, elevates roll, sets brakes.

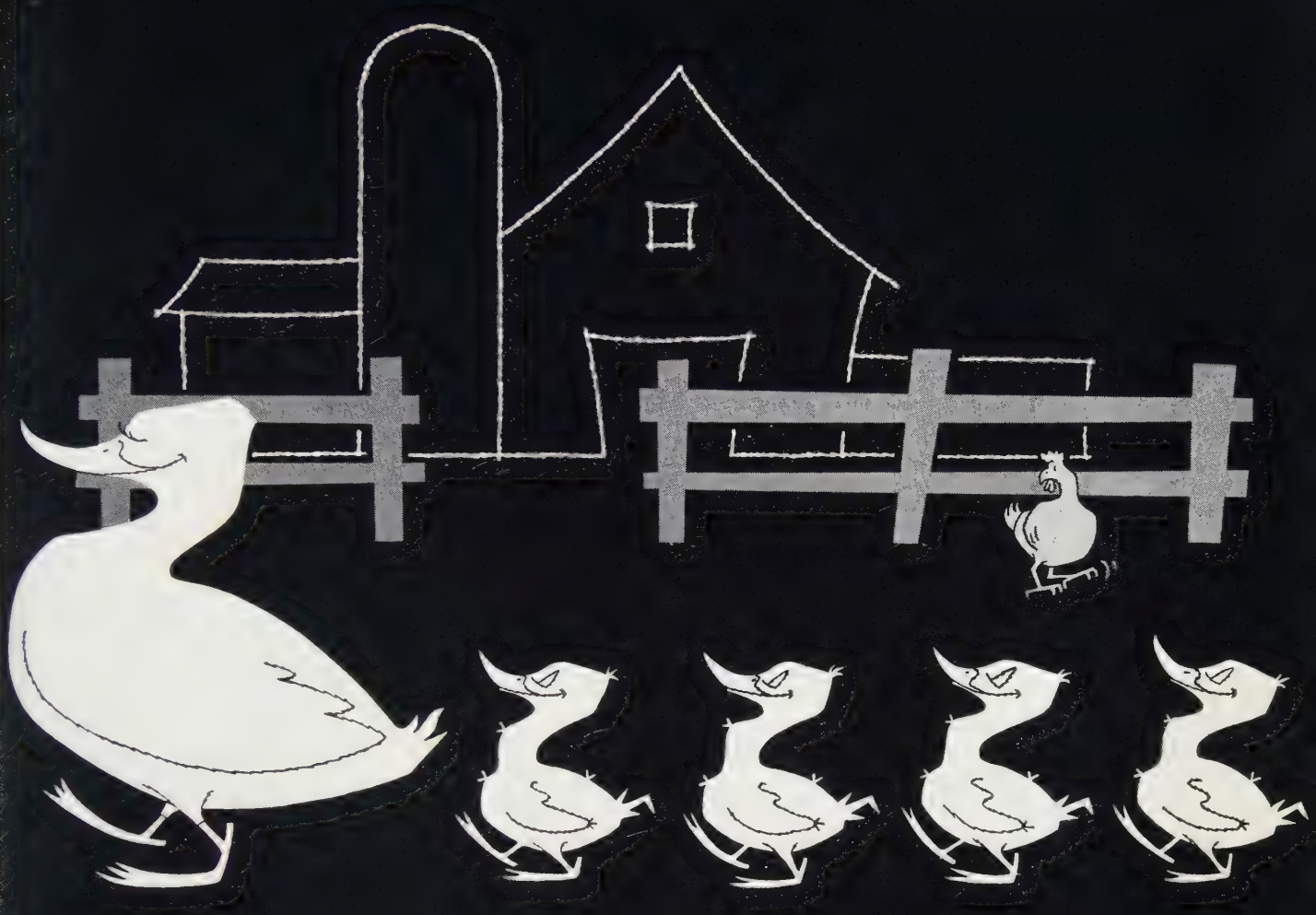
One man can load the heaviest roll. No heavy shaft to handle. No cone tightening. No couplings to engage. No crane lifting. Just pushbuttons. This is the Langston standard shaftless unwind stand for rewinding and converting applications.

You not only save time, you also get better unwinding. Roll can be positioned laterally by push-button control—even when the machine is running. It's held firmly under pressure for complete safety throughout the unwind. Several braking arrangements can be provided to handle a wide range of grades and conditions. Available extras provide for handling very narrow rolls; for constant tensioning; for automatic braking of idler rolls; for automatic web alignment and side register control; for web oscillation; and for local or remote control.

This new Langston shaftless unwind stand can be used with any make of slitter. Available for maximum roll widths from 36 to 140 in. and diameters from 14 to 84 in. For complete information, write Samuel M. Langston Co., Camden 4, N. J.

SHEAR CUT CLEAN CUT

LANGSTON *Leadership...by design*



Titanium Dioxide

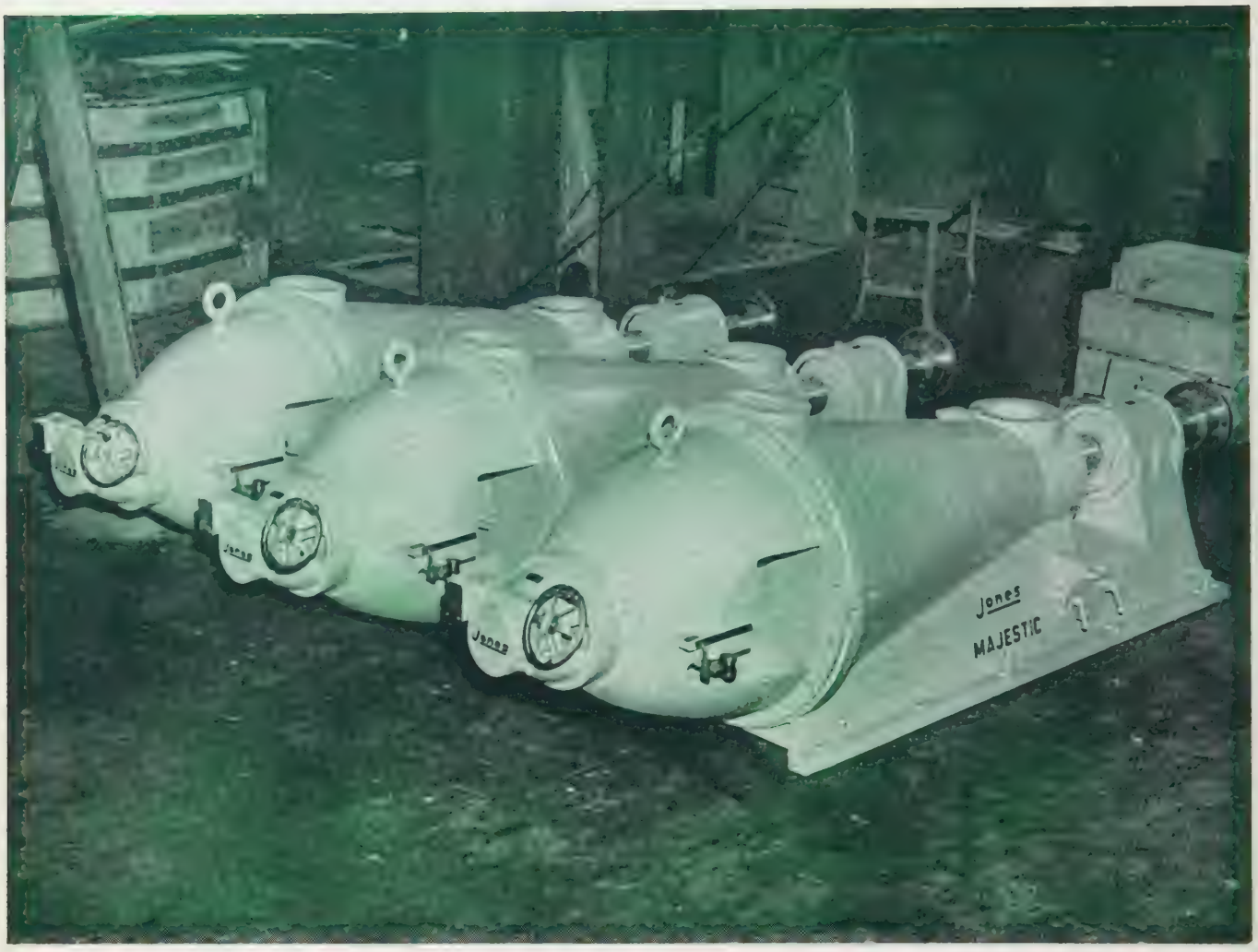
FOR UNIFORMITY

Uniform color and particle size mean uniform performance in paper. And all grades of UNITANE are of uniformly high quality to insure unsurpassed brightness, whiteness and opacity. Ask your Cyanamid Pigments representative about UNITANE.

CYANAMID

AMERICAN CYANAMID COMPANY, Pigments Division
30 Rockefeller Plaza, New York 20, N. Y.
Branch Offices and Warehouses in Principal Cities

New Jones Majestics



. . . precision built in our new plant for the world's newest mills

Some things *are* old about these Jones Majestics . . . quality refining results, efficiency of operation and ease of maintenance, for example. But otherwise practically everything else is *new* . . . like the simplified unit shell construction, the base-mounted scale to indicate plug position, the improved design of bearings, packing glands and Accruset adjusting mechanism. They're the first machines off the production line in Jones' new Pittsfield plant . . . and first choice of the world's newest and finest mills. For full details write to E. D. Jones Corporation, Pittsfield, Mass. Ask for Bulletin EDJ-1036.

New Jones Plant in Pittsfield is one of the largest pre-fabricated steel buildings in the country. In it are incorporated the very latest production methods and facilities to assure Jones' continued leadership in the field of pulp mill equipment and stock preparation machinery.

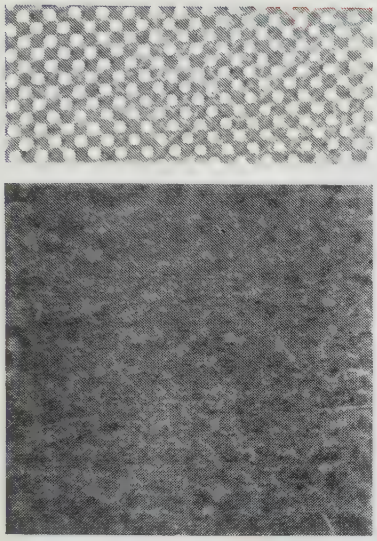
Canadian Associates:
The Alexander Fleck Ltd.
75 Spencer St., Ottawa

E. D. JONES CORP. · PITTSFIELD, MASS. · member BELOIT group

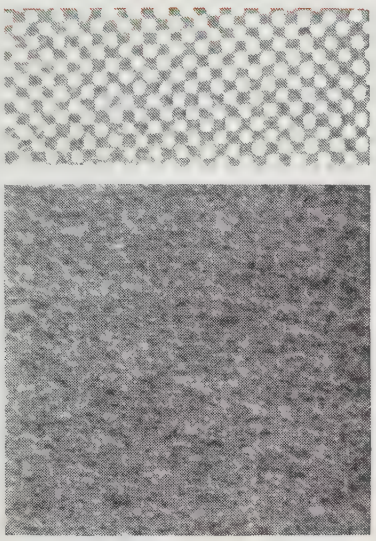
Jones

PULP MILL EQUIPMENT AND
STOCK PREPARATION MACHINERY

What an IMPROVEMENT IN UNIFORMITY



2% KELGIN XL PLUS STARCH



SAME RUN WITH STARCH ONLY

These highly-magnified unretouched photographs clearly show remarkable benefits provided by use of KELGIN XL® in improving uniformity of printing.

OF PRINTING

on paper and paper board

ACHIEVED BY KELCO ALGINS

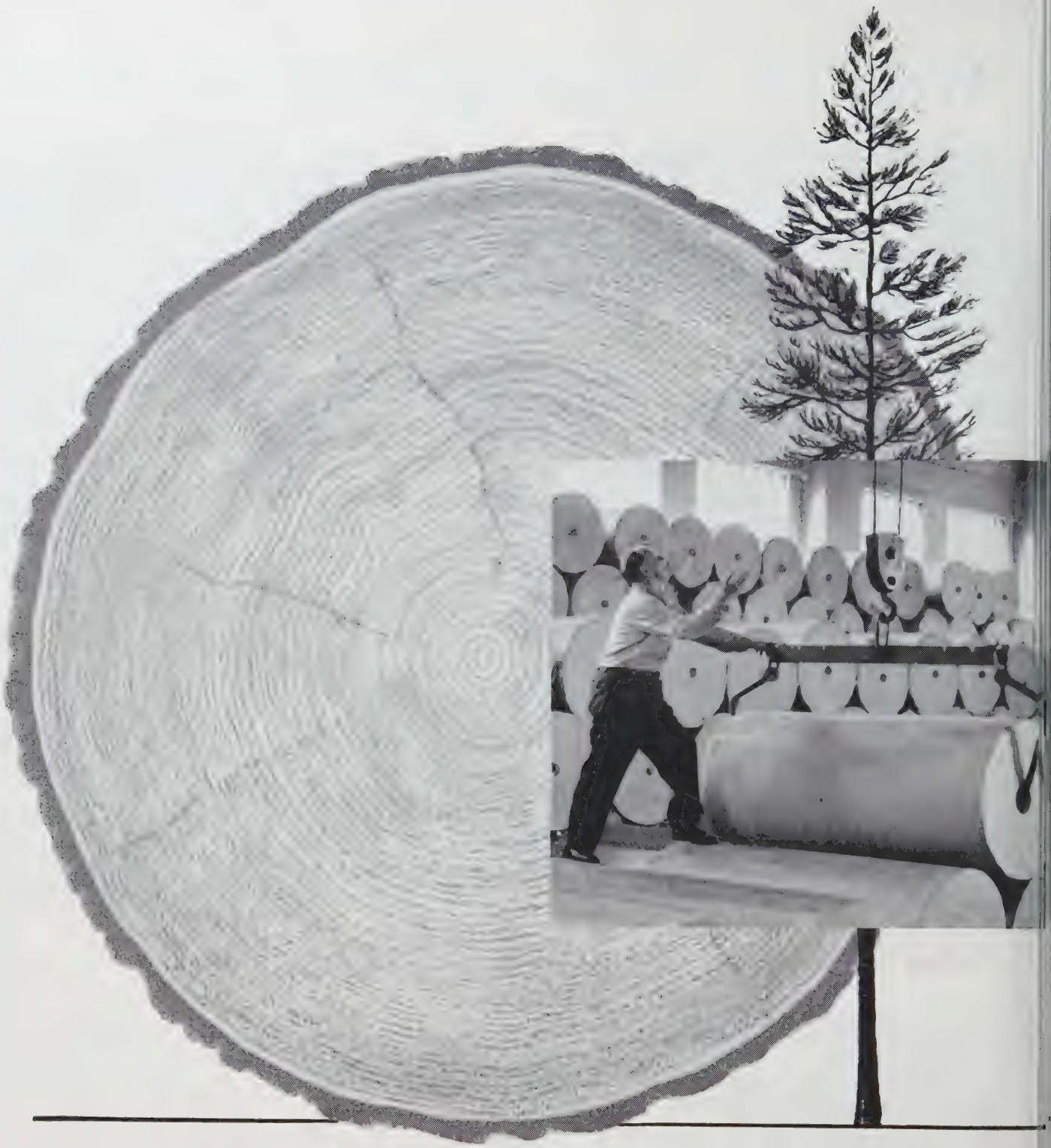
You, too, will achieve this kind of improved printability and achieve all these benefits by applying Kelgin XL solution to your paperboard:

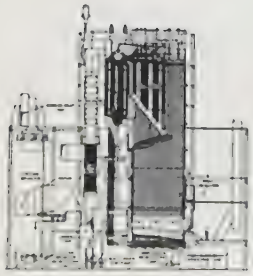
1. More uniform color. **2.** Although less color is used, increased color value is obtained. **3.** Better definition of printing. **4.** Degree of color penetration can be controlled precisely. **5.** Smoother board, increased density.

Start getting these advantages in your operation. Call or write your nearest regional office for a technical representative.

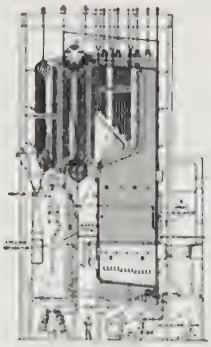
YOURS ON REQUEST: Technical Bulletin details latest data on Kelco surface sizing agents including specific solutions to problems of improving densometer, printability, uniformity, smoothness, reduction of machine down time.

products of **KELCO COMPANY**

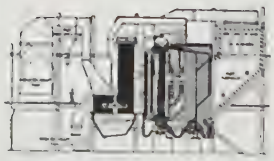




Kraft Recovery Boiler



Neutral Sulfite
Recovery Boiler



Magnesium Bisulfite
Recovery Boiler

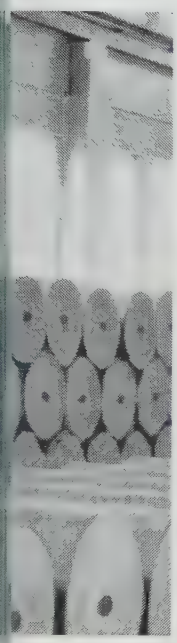
Venturi
Evaporator-Scrubber

Cyclone Evaporator

PROCESS

BABCOCK & WILCOX EQUIPMENT FOR THE PULP AND PAPER INDUSTRY

FOR CHEMICAL RECOVERY · PROCESS STEAM · POWER



Through constant research and engineering, B&W offers pulp and paper manufacturers equipment and systems adopting the latest operating practices and production advancements.

Recovery units for the Kraft process are now operating at higher pressures and temperatures to more economically meet the pulp and paper mills' expanding electric power requirements.

MgO recovery* is opening new areas of economical sulfite pulp production with recovery of both heat and chemical values from magnesium bisulfite waste liquors.

The recently introduced Magnefite pulping process* permits use of a wide variety of wood species and offers lower mill first-costs, and lower pulp production costs.

Power boilers operate at a wide range of steam pressures and temperatures for improved performance in generation of electricity, and for process steam.

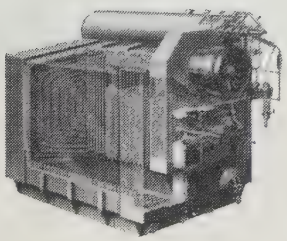
These are some of the more recent developments in the complete range of B&W equipment and processes that are the result of B&W's close relationship with the industry and its needs. Call in the B&W man at your next stage of mill development planning. He'll talk B&W equipment in your language. The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

**Exclusively available from The Babcock & Wilcox Company.*

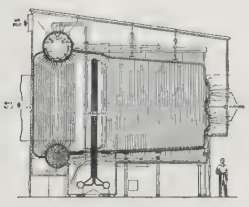
P-832

B&W THE BABCOCK & WILCOX COMPANY

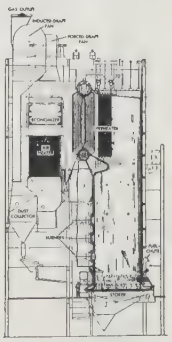
BOILER DIVISION



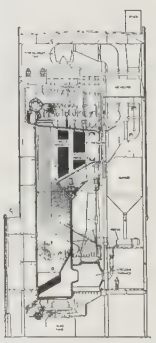
Type FM Package Power Boiler



PFI 400,000 lb hr Power Boiler



2-Drum Bark Burning Boiler



Radiant Boiler with Cyclone Furnace

POWER

WONDERWHITE:

FOR THE BEST IN BRIGHTNESS AND FORMATION

GBS+ClO$_2$ +R&D=

WONDERWHITE

You probably have heard paper manufacturers commenting on how WONDERWHITE achieves "high brightness without loss of opacity." But did you know that you also get this brightness in a fiber with unexcelled paper-making qualities?

Paper makers have always known that Northeastern Spruce has unexcelled paper making properties. Now, with WONDERWHITE, you have the forming and printing qualities available only in a spruce sulphite, plus the high brightness which only Chlorine Dioxide can give.

Maybe this pulp is the answer to a number of your problems. May we suggest a trial shipment? You'll soon see why we called it WONDERWHITE.

GASPESIA SULPHITE COMPANY LTD.
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SALES REPRESENTATIVE IN THE UNITED STATES:
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for the paper industry

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Chemical specialty products
for pulp and paper processing

Quality
AHCO PRODUCTS
Integrity

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55 Canal Street, Providence, Rhode Island • Est. 1815
A Subsidiary of Imperial Chemical Industries Limited, England
West Coast Representative: Chemical Manufacturing Company, Incorporated of California

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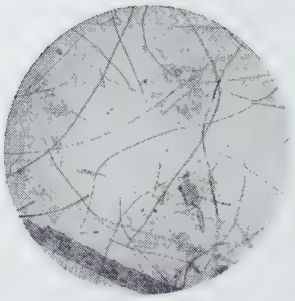
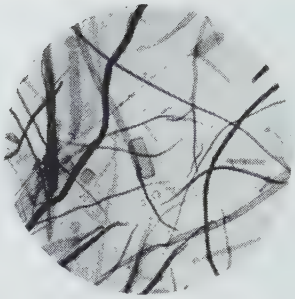
WHEAT STRAW



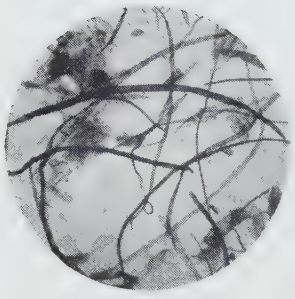
RICE STRAW



REEDS
(phragmites communis)

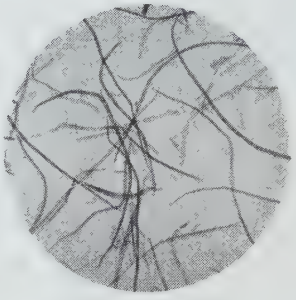
ELEPHANT GRASS
(before cleaning)

We build pulp and paper mills

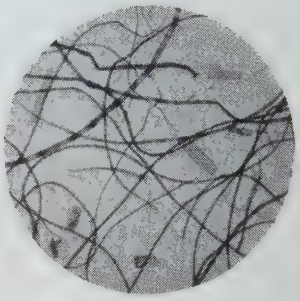


CORN STALK
(before depithing)

SUGAR CANE BAGASSE
(completely depithed)



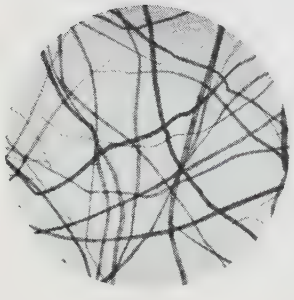
ESPARTO GRASS



BAMBOO

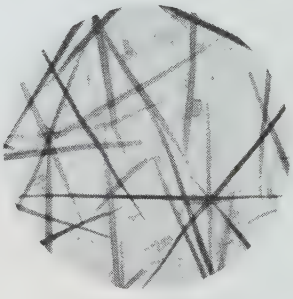
around the world

magnification:
approx. 35x



KENAF

MANILA HEMP



EUCALYPTUS SALIGNA

MONTEREY PINE

using these locally-abundant raw materials

Many countries have improved their economic position by making pulp and paper from locally-abundant grasses, woods and agricultural fibers. They began by having Parsons & Whittemore conduct a thorough technical and economic field survey. The selection of the proper process and equipment for use of such fibers is dependent upon many factors that can only be properly evaluated by highly-experienced personnel.

Field research is only one of Parsons & Whittemore's services. Our organization has world-wide technical, financial and machinery-manufacturing facilities that enable us to plan and supervise the designing, engineering, financing, construction and equipment of pulp and paper mills in any country having the required raw materials. We will even train local workers to operate the mill...and our branch offices will arrange for the sale of the plant's pulp and paper output on world markets. For information on any or all of these services, write to our nearest office.

THE PARSONS & WHITTEMORE / LYDDON ORGANIZATION

World leaders in the development of pulp and paper mills for the use of local fibers

18-19 Savile Row, London W.1, England

5 Rue Jean Mermoz, Paris 8°, France

250 Park Avenue, New York 17, N.Y.

new treatment gives super high gloss to packages coated with A-C Polyethylene

new heat treatment using A-C® Polyethylene eveloped by Semet-Solvay imparts *super* high oss to waxed paperboard . . . lets you dispense ith overwrapping in many cases. It's ideal for ozen food and ice cream packages . . . butter id oleo . . . bread wrappers.

You can use this new technique while realizing all the advantages of A-C Polyethylene wax coatings: greater resistance to grease, moisture, scuffing and abrasion . . . smooth plastic-like feel . . . positive lock at freezing temperatures . . . brighter printing effects.

For details on *super* high gloss with A-C Polyethylene, write us at the address below.

Allied Chemical

SEMET-SOLVAY PETROCHEMICAL DIVISION

Dept. 577-E, 40 Rector Street, New York 6, N. Y.

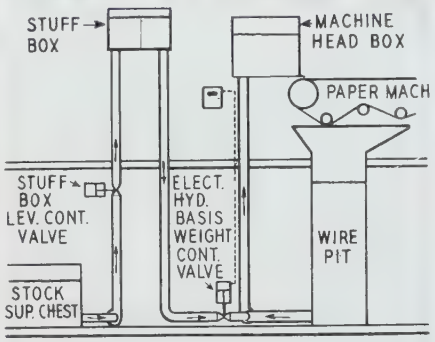
National Distribution • Warehousing in Principal Cities

EXACT and CONSTANT

BASIS WEIGHT CONTROL

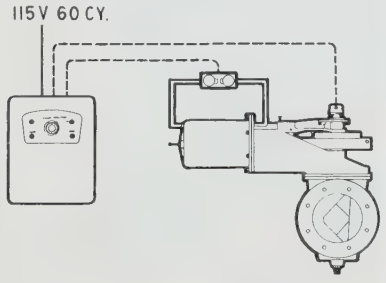
with the DeZurik ELECTRIC-HYDRAULIC VALVE

Application



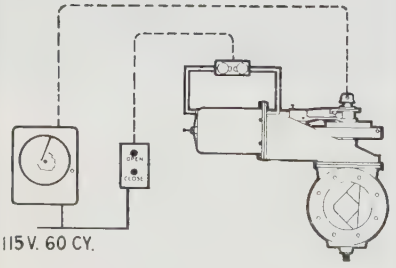
The Electric - Hydraulic Actuator mounted on a DeZurik Vee Port Valve, provides greater accuracy and repeatability than is obtainable with a stuff gate.

The diamond-shaped orifice of the DeZurik Vee Port Valve guarantees constant flow without plugging.

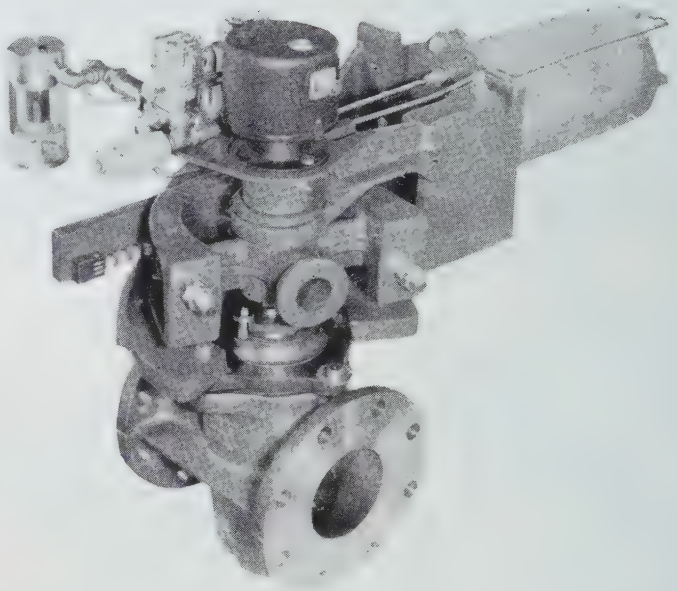


A manual control station can be furnished which will provide accurate control of the valve.

With this station the valve can be set in 2000 repeatable positions.



A push button station can also be used in conjunction with an electronic recording instrument. Because valve position is a function of basis weight, changes in basis weight are recorded on the chart.



Now—at last—IT IS POSSIBLE TO DELIVER AN EXACT AND CONSTANT AMOUNT OF STOCK TO THE FAN PUMP! The DeZurik Precision Electric-Hydraulic Basis Weight Control Valve provides completely stable control with excellent sensitivity and repeatability.

When controlled by a Beta Gage, this DeZurik Valve will provide the ultimate in fine control. The electrical signal from the Beta Gage is instantly translated into positive action of the hydraulic cylinder without the backlash of electric motor drives.

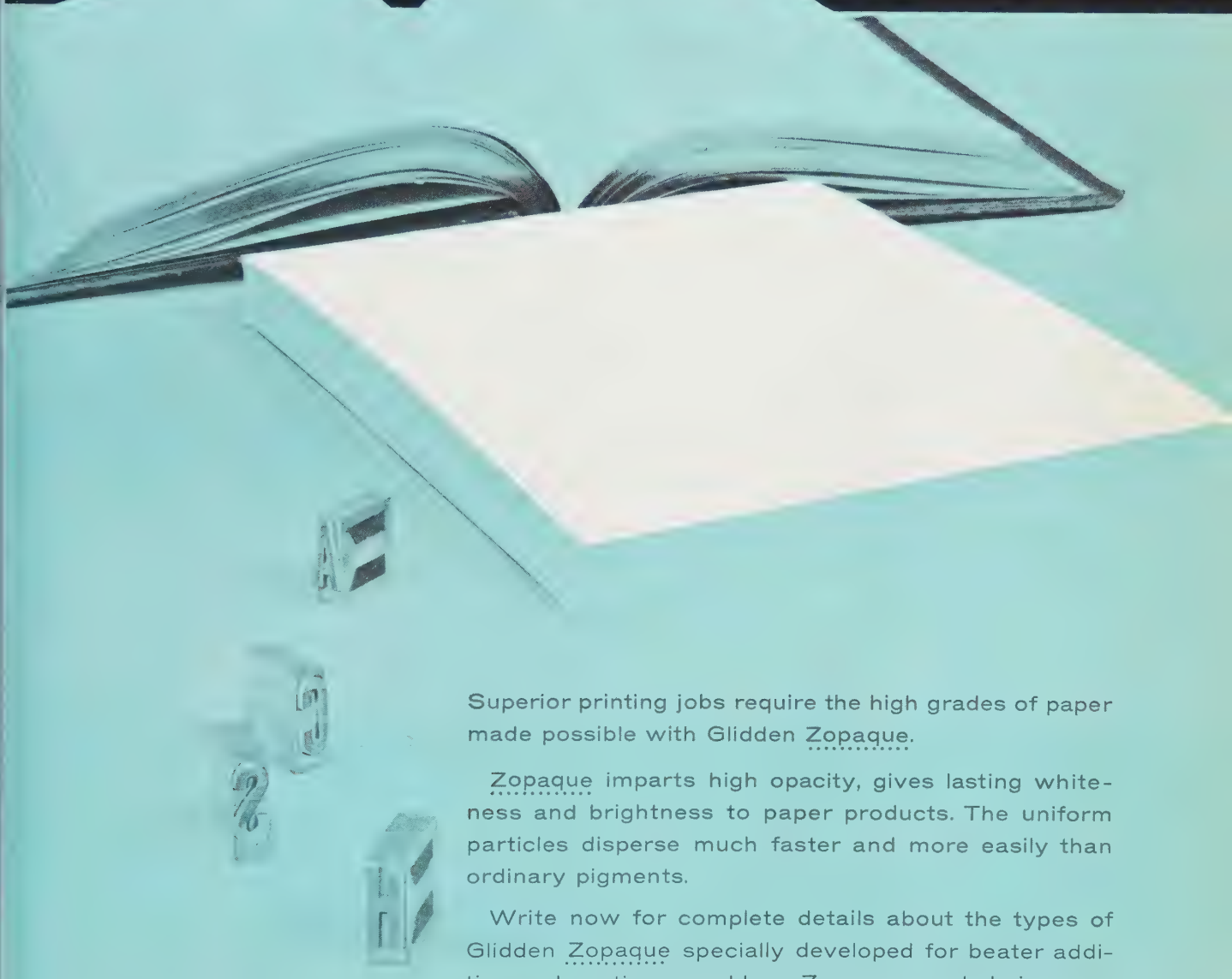
Here are some additional features: Completely adjustable speed; Positive readout of valve position; Provision for manual operation.

Write for more information.

DeZURIK CORPORATION
SARTELL, MINNESOTA

Highly Impressionable

Printing papers with finest reproduction qualities are made with Glidden Zopaque® Titanium Dioxide



Superior printing jobs require the high grades of paper made possible with Glidden Zopaque.

Zopaque imparts high opacity, gives lasting whiteness and brightness to paper products. The uniform particles disperse much faster and more easily than ordinary pigments.

Write now for complete details about the types of Glidden Zopaque specially developed for beater addition and coatings—and how Zopaque can help improve whatever paper products you manufacture.

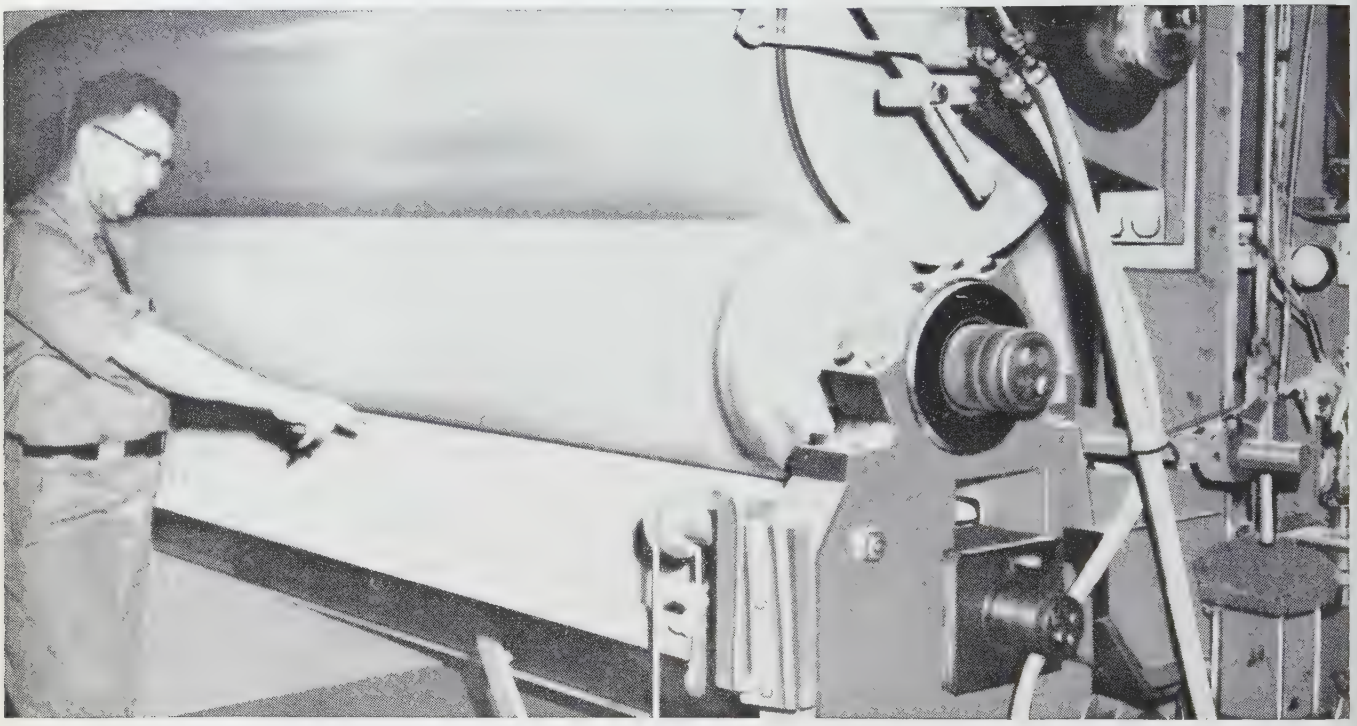
QUALITY Glidden PRODUCTS

FINEST PIGMENTS FOR INDUSTRY

The Glidden Company
Chemicals—Pigments—Metals Division
Baltimore 26, Maryland

(This advertisement is printed on paper stock containing Glidden ZOPAQUE Titanium Dioxide.)

DYLEX® K-52 latex improves quality of enamel-coated paper at WESTVACO



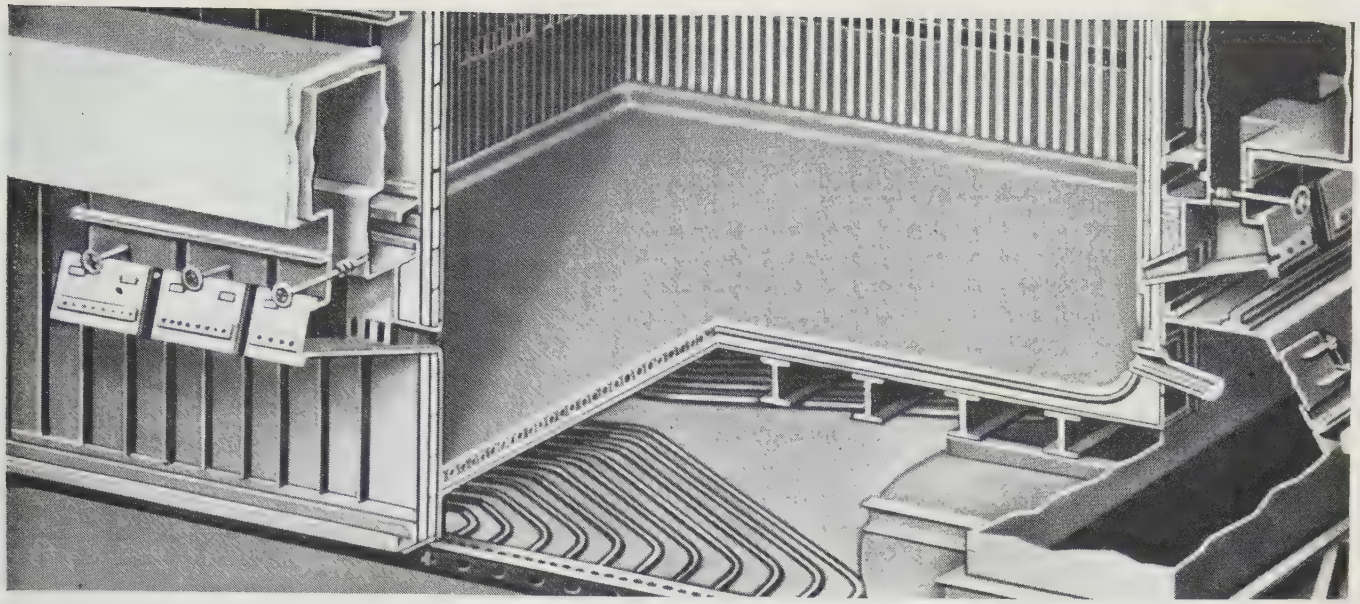
West Virginia Pulp and Paper Company produces more than 1,000,000 tons of paper per year. This year, output of the Fine Papers Division mill in Luke, Maryland, will be doubled with the addition of two giant, fine papermaking machines of the most advanced design.

WESTVACO, a pioneer in machine coating, has found a way to improve the quality of their enamel-coated paper. They use styrene-butadiene latices as an additive in the machine-coating operation. Production supervisors at this Fine Papers Division mill report that they are pleased with the uniformity of DYLEX K-52 and its compatibility with other coating materials.

Paper coated with DYLEX K-52 is ideal for modern, high-speed printing presses because it has greater resistance to surface rupture. This coating also gives a higher gloss, excellent mechanical stability, improved pick resistance, and smoother surface which results in better printing reproduction. DYLEX K-52 is easy to apply and can be used alone or with starch or protein.

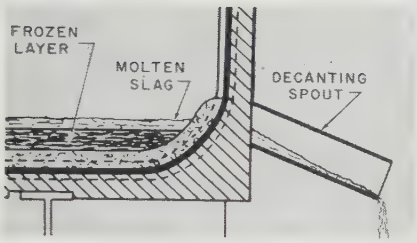
Get complete information about latex coating! Call our local sales representative, or write for our free pamphlet on DYLEX K-52 . . . complete with charts and test data. Koppers also produces DYLEX K-54 and DYLEX K-85 for the paper industry. Contact Koppers Company, Inc., Plastics Division, Pittsburgh 19, Pennsylvania.

KOPPERS PLASTICS KOPPERS

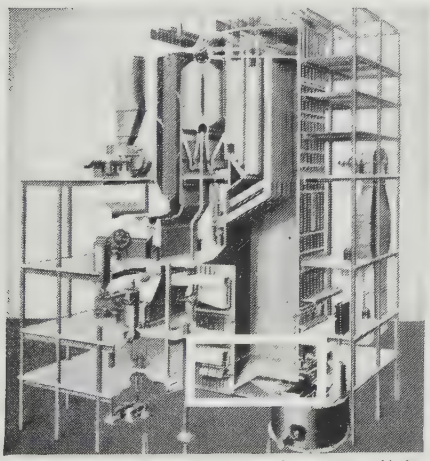


Cutaway view of the C-E hearth showing watercooled floor and decanting spout.

Watercooled Decanting Hearths Score 157 Maintenance-Free Years



Molten slag never touches furnace floor, preventing damage to hearth and contamination of slag by eroded refractory.



One of the latest C-E Chemical Recovery Units — an important part of the modern kraft pulp process. Note that slag from waterscreen and superheater can fall directly to hearth.

. . . in 50 C-E recovery units

Since the development of the watercooled decanting hearth by Combustion Engineering in 1951, 50 C-E Chemical Recovery Units have served an aggregate of 157 years *completely free from hearth maintenance.*

The decanting principle — key to this durability — employs a *level,* watercooled furnace floor. A layer of solidified slag, kept frozen by the watercooling, covers the floor. Molten slag resting on this hardened surface drains off (decants) through a spout located several inches above the frozen layer. Hearth refractory and floor tubes are never exposed to erosion by the hot liquid slag, hence rarely need repair.

The C-E Decanting Hearth eliminates a common cause of furnace shutdowns. Other C-E advances offer improved recovery unit control, flexibility and efficiency. And, because of the high availability experienced with modern C-E recovery units, pulp mills can now depend on one large-capacity unit in place of two smaller ones — with considerable savings in the cost of maintenance and operation. For interesting details, call the C-E office nearest you or contact the C-E Paper Mill Division in New York.

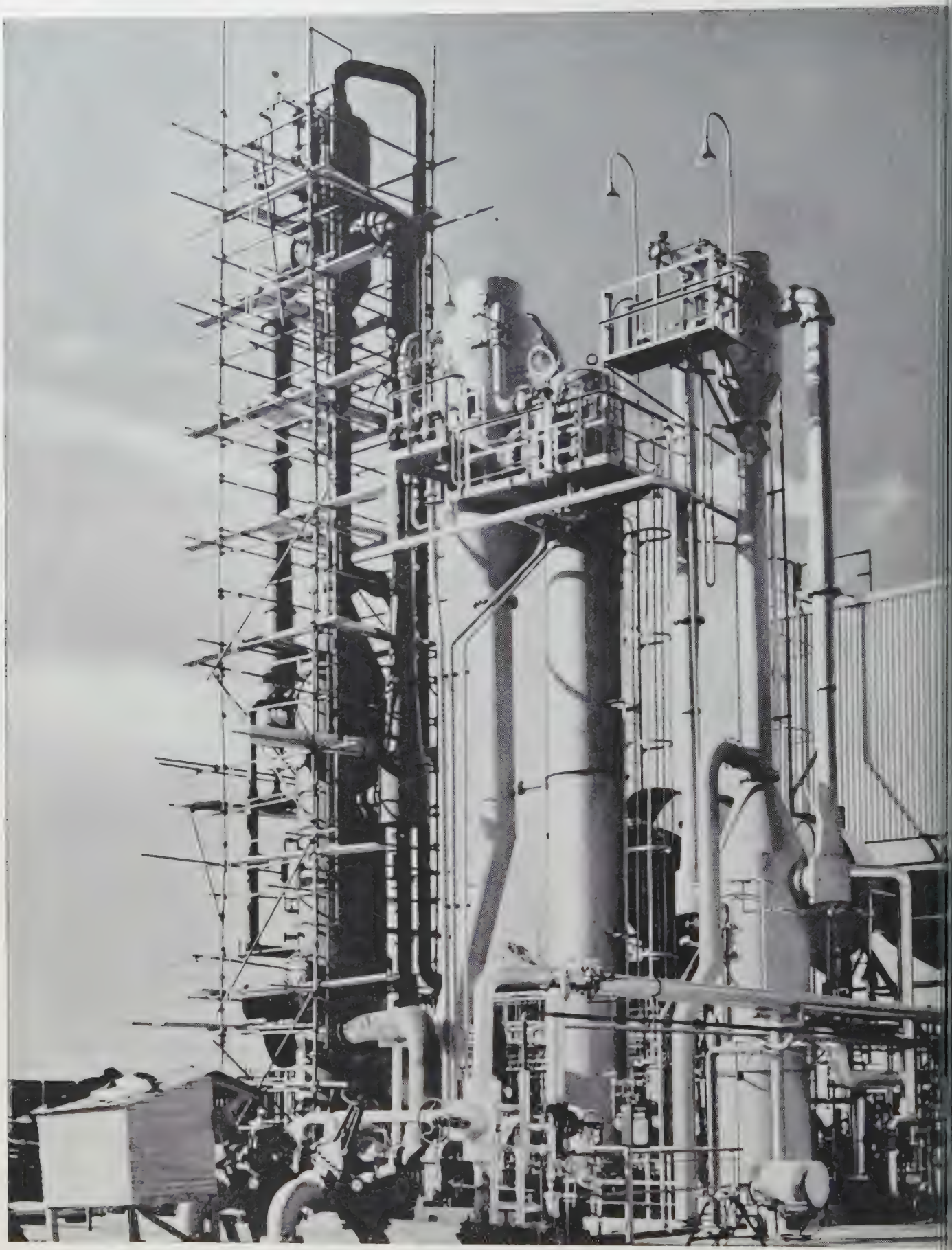
COMBUSTION ENGINEERING

C-269

Combustion Engineering Building, 200 Madison Avenue, New York 16, N. Y.

CANADA: Combustion Engineering-Superheater Ltd.

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE



PETROTHENE® RESINS FOR FILM AND COATING. Capacity of this U.S.I. plant at Houston, Tex., is being expanded to 200 million pounds of polyethylene per year. U.S.I. also produces 100 million pounds of polyethylene per year at its Tuscola, Ill., plant complex.

U.S.I.'s MANY PLANTS PROVIDE AMPLE SUPPLIES OF PAPER CHEMICALS

for pulping
for converting
for packaging

From chlorine and caustic for bleaching pulp—to polyethylene resins for coating paper and board—U.S.I. is a dependable source of chemical products for the paper industry.

With two chlorine and caustic plants at Huntsville, Alabama—conveniently located in relation to a large number of pulp and paper mills—U.S.I. can offer rapid delivery and prompt technical assistance on these products. Liquid chlorine is available in tankcars. Commercial grade 50% caustic soda is shipped in tankcars, tank trucks, barges.

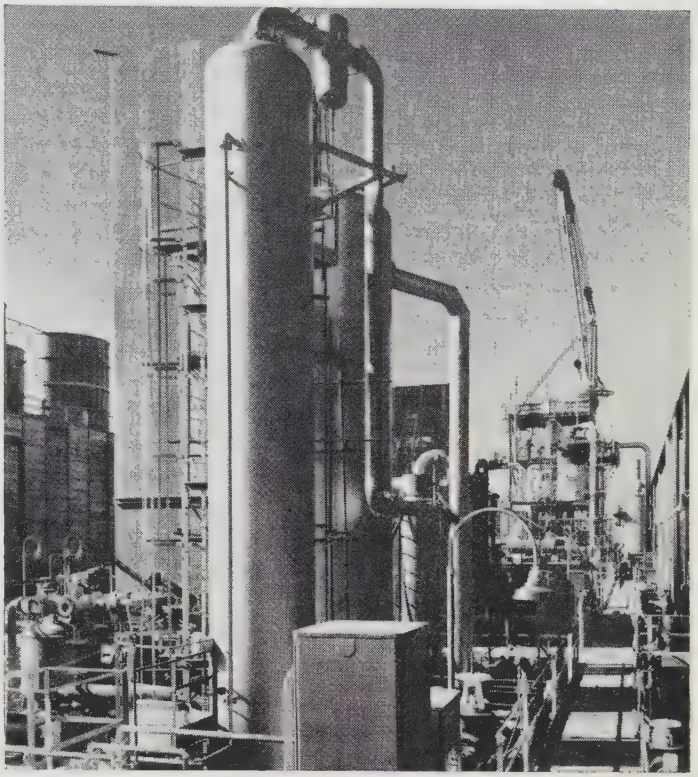
Two other important paper chemicals—sodium peroxide and ammonia—are also available from U.S.I. Sodium peroxide is produced at Ashtabula, Ohio; ammonia at Tuscola, Illinois.

With U.S.I.'s latest polyethylene resin plant expansion at Houston, Texas—and facilities at Tuscola, Illinois—the company's total polyethylene capacity will soon reach 300 million pounds per year. This will make U.S.I. the world's second largest producer.

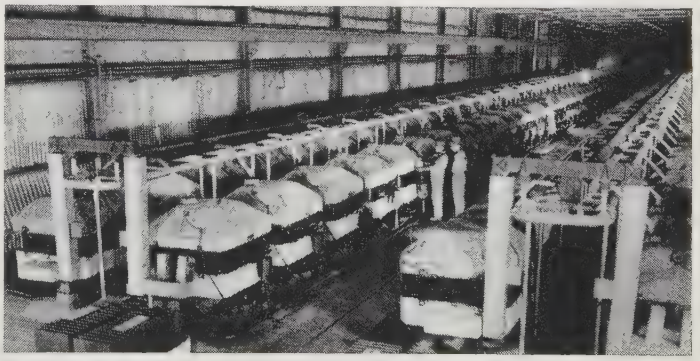
As part of the company's program to assist polyethylene customers, U.S.I. has come up with significant developments in resins for the paper industry. For example, PETROTHENE® 205-15—one of four new U.S.I. resins for paper coating—exhibits greater greaseproofness at any given coating weight than other resins of similar melt index and density. All four resins are tailored for high adhesion, and reduced neck-in, smoking and polymer build-up at the die.

U.S.I. has also pioneered the new technique for producing crystal-clear cast polyethylene film, and has just released new resins for this purpose. More and more converters are packaging with polyethylene now that the clarity problem has been solved, because of the enhanced shelf life which this film gives to paper products.

U.S.I. has a pulp-to-package interest in the paper industry's growth. To take advantage of our research and development work, large capacity, prompt technical service, write or call your nearest U.S.I. sales office, or company headquarters in New York.



AMMONIA is made at this U.S.I. plant at Tuscola, Ill. Polyethylene resins are also produced at Tuscola by U.S.I.



CHLORINE & CAUSTIC SODA. One of the two U.S.I. plants at Huntsville, Ala., producing these basic chemicals for the pulp and paper industry.

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers and Chemical Corp.
99 Park Ave., New York 16, N. Y.
Branches in Principal Cities

CHLORINE • CAUSTIC SODA • SODIUM PEROXIDE • AMMONIA • PETROTHENE® POLYETHYLENE RESINS

The KADY® MILL

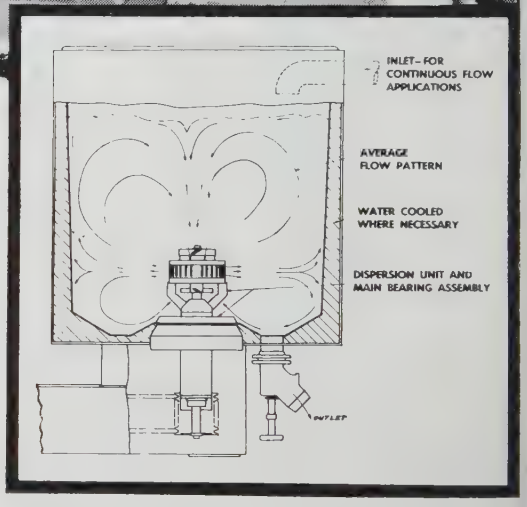
COATING COLOR

in

MINUTES

instead of

HOURS



- ★ **Cook Protein, Casein or Starch in presence of pigment efficiently and economically.**
- ★ **Color for Machine or Off Machine coating in one operation.**
- ★ **Low Viscosity with high solids.**
- ★ **Reduce Binder percentage.**
- ★ **Develops optimum opacity and gloss.**

Over 50 paper plants have approved the advantages and economy of coating color production by the KADY method. The uniformity of viscosity, optimum value from Ti 0_2, calcium carbonate, satin white and from whichever adhesive or combination of adhesives used, prove the superiority of the KADY method to any other.

If you want continuous processing or have a color system deaerating problem to overcome, let us give you the complete story of KADY applications to suit your specific requirements. Many quality control problems on all types of coaters are being solved effectively, color application improved and superior finish obtained by a simple, low cost installation of a KADY MILL!

* *Pictured above is the 200 gallon model 4BH-60. Other models, including the new T series, in capacities from ½ to 750 gallons.*

Convenient Lease or Time Payment Plan

KADY® proven best in WORLD WIDE installations:

- United States
- Canada
- England
- Norway
- Sweden
- Finland
- Denmark
- Germany
- France
- Belgium
- Japan
- Mexico

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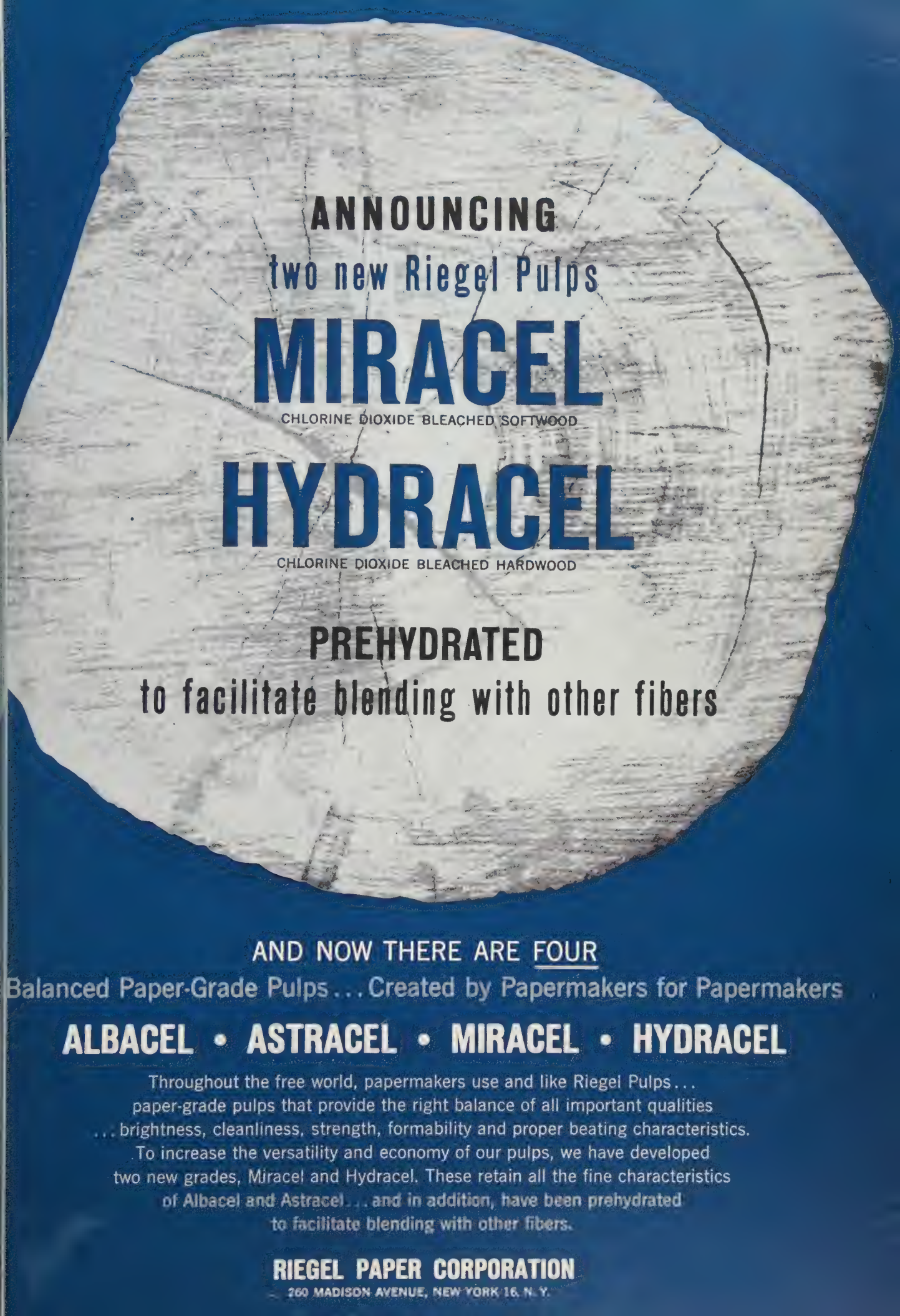
KADY INTERNATIONAL (EUROPA) N.V.
RAAMGRACHT 4
AMSTERDAM - HOLLAND

Kinetic Dispersion corp.

Buffalo, N. Y. 95 Botsford Place



AND NOW THERE ARE FOUR

Balanced Paper-Grade Pulps . . . Created by Papermakers for Papermakers

ALBACEL • ASTRACEL • MIRACEL • HYDRACEL

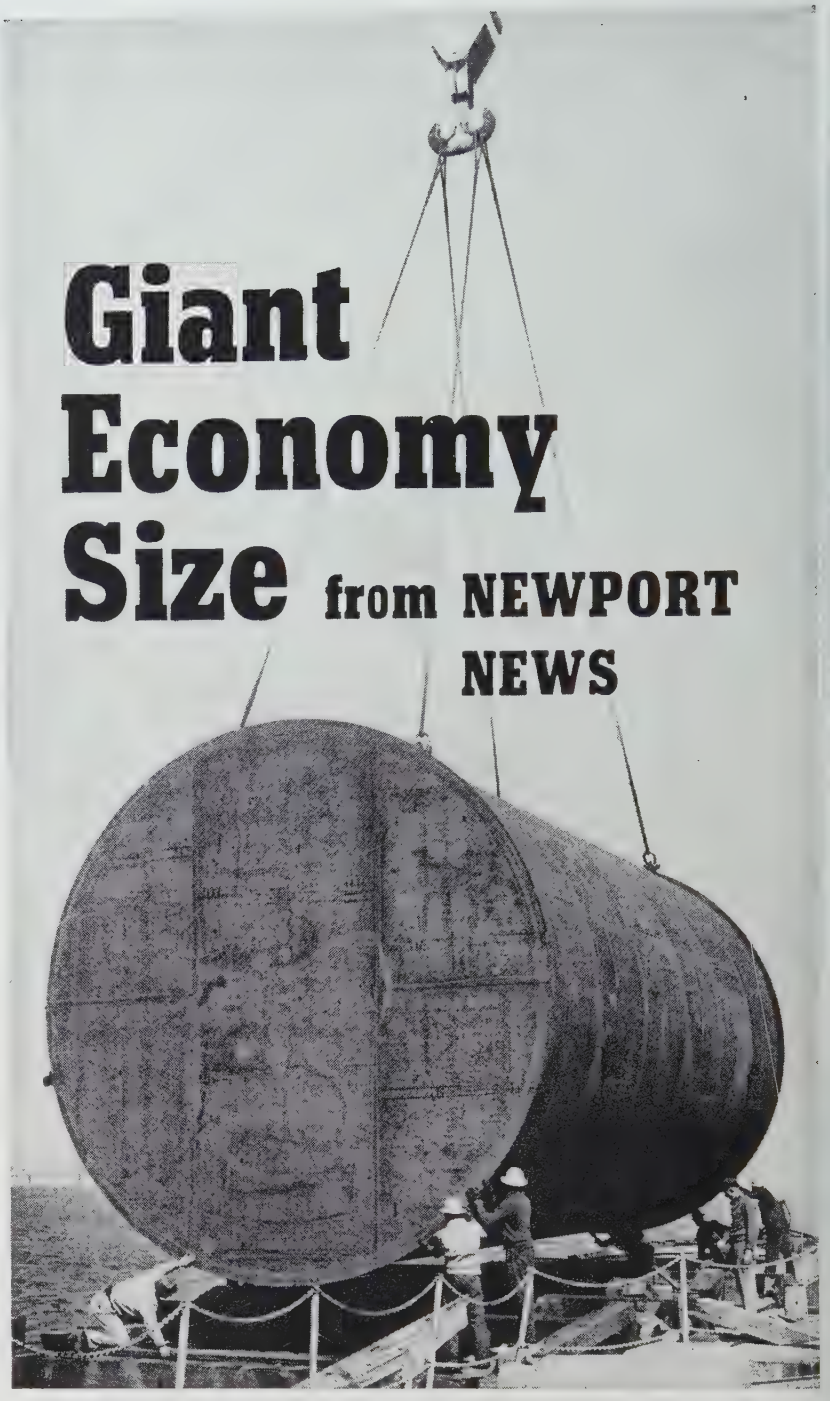
Throughout the free world, papermakers use and like Riegel Pulps . . . paper-grade pulps that provide the right balance of all important qualities . . . brightness, cleanliness, strength, formability and proper beating characteristics. To increase the versatility and economy of our pulps, we have developed two new grades, Miracel and Hydracel. These retain all the fine characteristics of Albacel and Astracel . . . and in addition, have been prehydrated to facilitate blending with other fibers.

RIEGEL PAPER CORPORATION

260 MADISON AVENUE, NEW YORK 16, N. Y.

Why a Southern paper mill ordered the...

Giant Economy Size from NEWPORT NEWS



Papermakers usually encounter some perplexing problems when pressure vessels, digesters, tanks or similar large size units are involved.

For instance, a southern paper mill required ten lime storage tanks like the one pictured here. The size, 20 feet in diameter by 40 feet in length, obviously prohibited one-piece delivery by rail.

However, the mill found a way to eliminate field assembly problems and avoid needless labor costs, as well as to save valuable erection time . . . by handing the job to Newport News.

Specialists in metal fabrication, Newport News produced these tanks in the shop, then loaded them on barges for direct shipment, fully assembled, ready for immediate installation upon arrival.

This illustrates how deep water shipping, along with sixty-seven years' experience in building just about any kind of vessel you could name, has enabled Newport News to provide money-saving answers for scores of papermakers.

Papermaking equipment built by Newport News has set outstanding performance records in leading mills at home and abroad. So whether you use *rolls or log barkers . . . head boxes or pressure vessels . . . digesters, tanks or special equipment . . .* let us bid on your needs. Learn how Newport News can help you . . . our illustrated booklet *"Facilities and Products"* is yours for the asking. Write for your copy today.

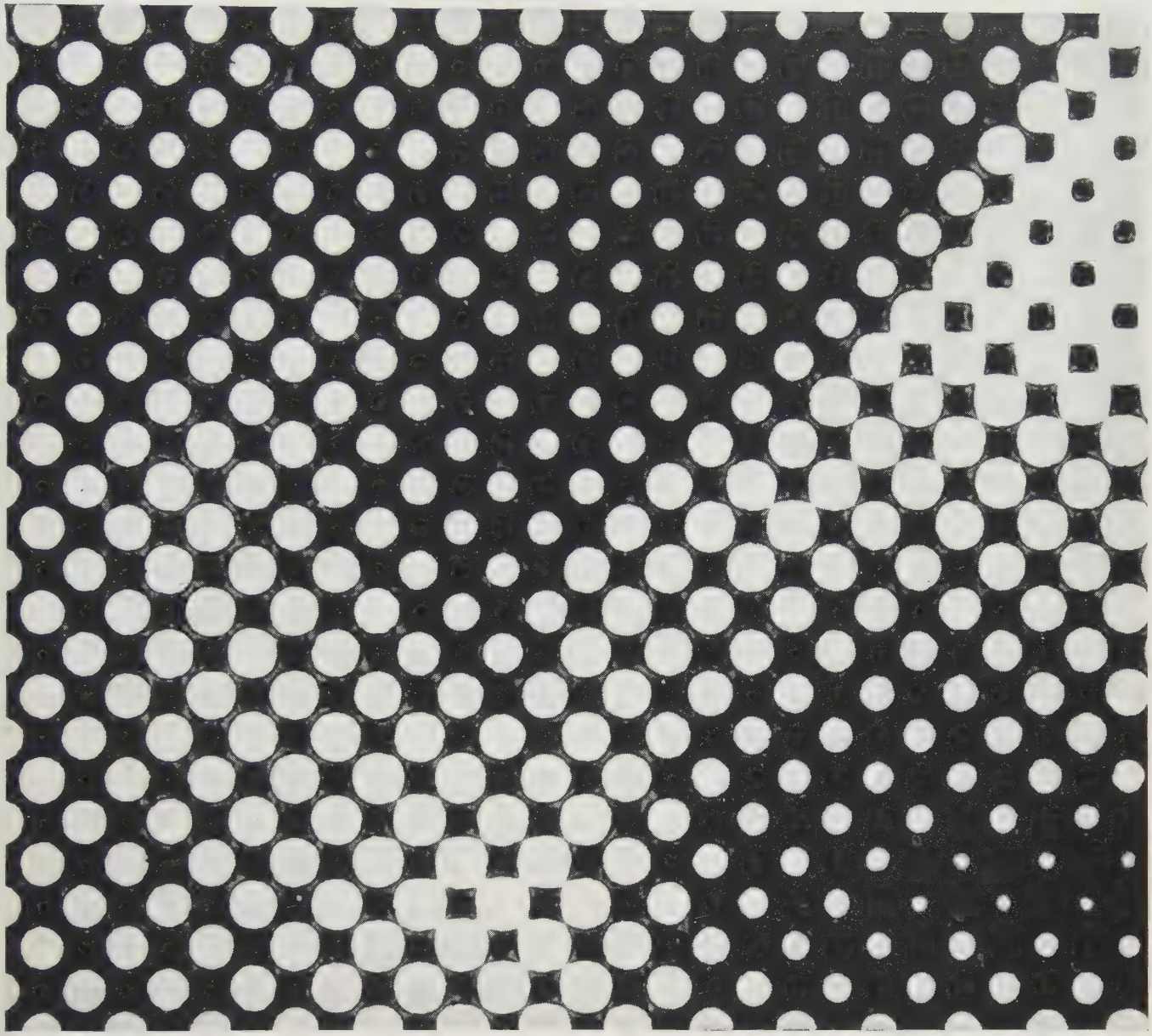
Nine more to go. You're looking at one of ten lime storage tanks being loaded on a barge for direct shipment from Newport News' plant. Complete assembly of these units in the shop not only saves labor and money but expedites installation upon arrival at the paper mill.

Newport News

Shipbuilding and Dry Dock Company

Newport News, Virginia

DOW | LATEX



120-line screen letterpress impression magnified 23 times shows the sharp, clean printing that results from the smooth surface achieved with new Dow Latex 630.

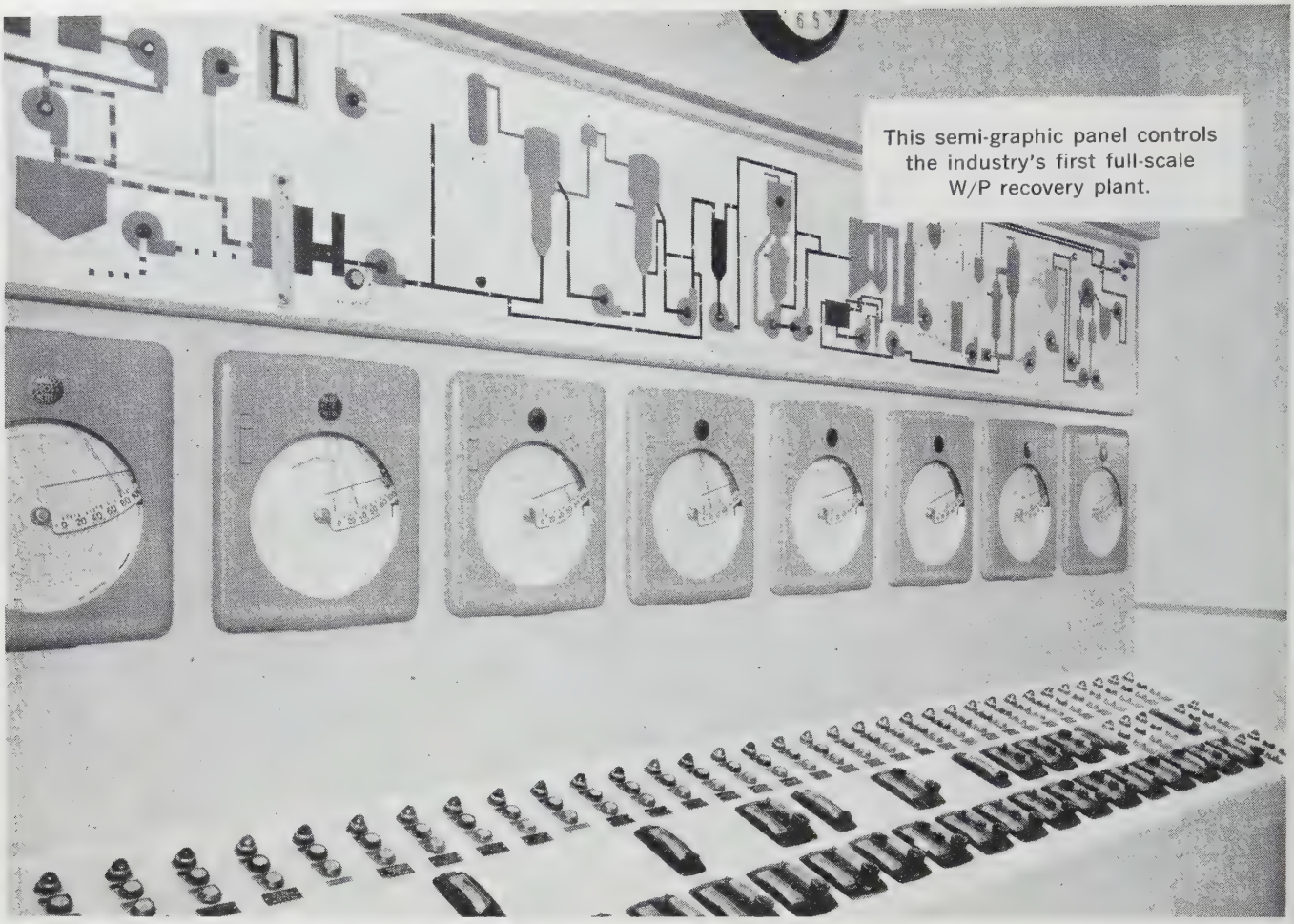
Now... better paper surface... better printing...
with **NEW DOW LATEX 630**

- **Superior Pick Resistance!**
- **Excellent Mechanical Stability!**
- **Excellent Starch Compatibility!**

With NEW DOW LATEX 630 in your coatings, your paper can set a new high standard for printability. Clear, sharp, true-to-life reproductions . . . because the paper surface is smoother, more uniform and more resistant to picking. Dow Latex 630 was developed to give you every manufacturing and sales advantage.

Dow is ready to help put Dow Latex 630 to work for you on better paper . . . for better profits. Write to THE DOW CHEMICAL COMPANY, Midland, Michigan, Coatings Sales Department 1935FC8.

THE DOW CHEMICAL COMPANY · MIDLAND, MICHIGAN



This semi-graphic panel controls the industry's first full-scale W/P recovery plant.

NERVE CENTER for first installation of W/P recovery process

This semi-graphic panelboard is regarded as one of the major advances in process instrumentation for the pulp and paper industry.

The reasons:

**A New Process is Involved:*

This panelboard is located at the new recovery plant of Consolidated Water Power & Paper Company, Wisconsin Rapids, Wis. It is the nerve center for the first commercial-scale installation of the Western Precipitation Corporation's new recovery process. Long sought by the industry, the W/P system provides a new approach to processing both acid sulphite and semi-chemical spent liquors.

**Panel Represents Advanced Automation*

The panel is no mere mounting for controls, recorders and control stations . . . it provides an exceptionally advanced degree of intelligence to reduce manpower required in the operation of a highly complicated processing system.

This comprehensive installation is another example of how Bailey is working with pulp and paper processors toward greater degrees of automation, efficiency and quality control.

Put Bailey's 40 years of engineering leadership to work for you. Your Bailey Engineer will be happy to review your plant operation and to suggest applications that will bear immediate return. Check phone book for nearest Bailey District Office, or write direct to our Pulp and Paper Division.

**For further information*, write to the Bailey Meter Company for Reprint No. C-30, "Consolidated Demonstrates Its Recovery of Spent Sulphite Liquors."

P150-1

PULP AND PAPER DIVISION

BAILEY METER COMPANY

1077 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

BAILEY METERS

THERE ARE MORE THAN TWO SIDES TO AN AP-PLY FELT!

Top and bottom, of course, but there is also the research side, design side and production side. Your Appleton man knows every side of the felt business (how else could he solve so many *different* felt application and performance problems for so many different companies?). Why not ask him to take a look at your side of the felt performance problem? You'll be glad you did!

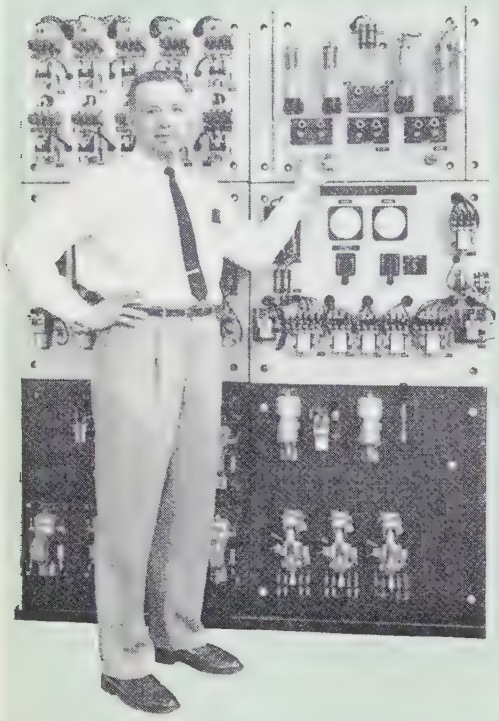
AP-PLY FELTS

Appleton Woolen Mills

Working With The Paper Industry

Appleton, Wisconsin

"Reliance drive to power third machine at Marathon Southern



R. E. Farrell, Application Engineer, Paper Manufacturing, Reliance Electric & Engineering Co.

"Marathon Southern is expanding to provide for a third paper machine; the drive will be Reliance, because of their experience on the first two machines.

"Marathon's No. 1 Yankee tissue machine has a sectional electric drive. The No. 2 paper machine has a Reliance helper drive on the Fourdrinier, presses and size press."

Reliance VSMR electronic regulators and drives control the two paper machines in this mill. The VSMR operates on a dual-circuit 'fail-safe' principle, to assure continuity.

Paper and other industries are well aware that Reliance can give them exactly what they want in drives, motors and controls. Check your nearest Reliance Sales Engineer. He'll give you application and engineering help or, if you prefer, write us direct for information. L-1661

Product of the combined resources of Reliance Electric and Engineering Company and its Master and Reeves Divisions

RELIANCE ELECTRIC AND ENGINEERING CO.

DEPT. 198A, CLEVELAND 17, OHIO
Canadian Division: Toronto, Ontario
Sales Offices and Distributors in Principal Cities

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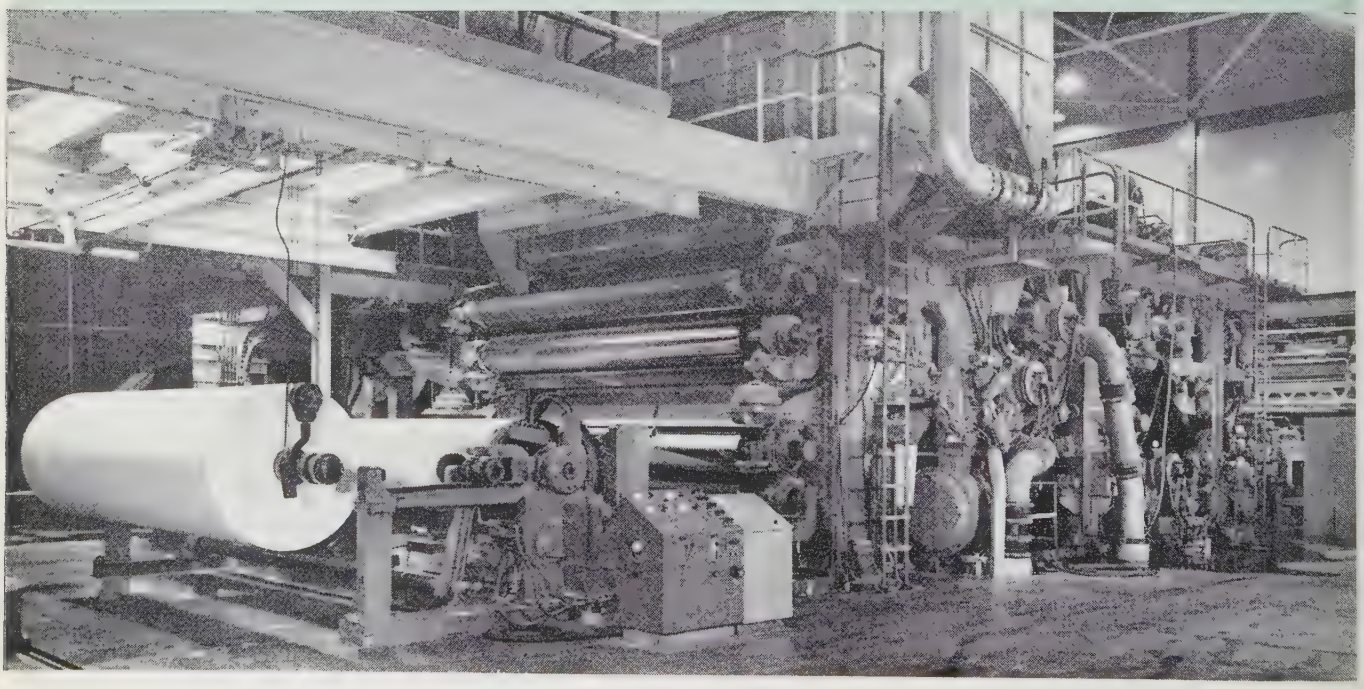

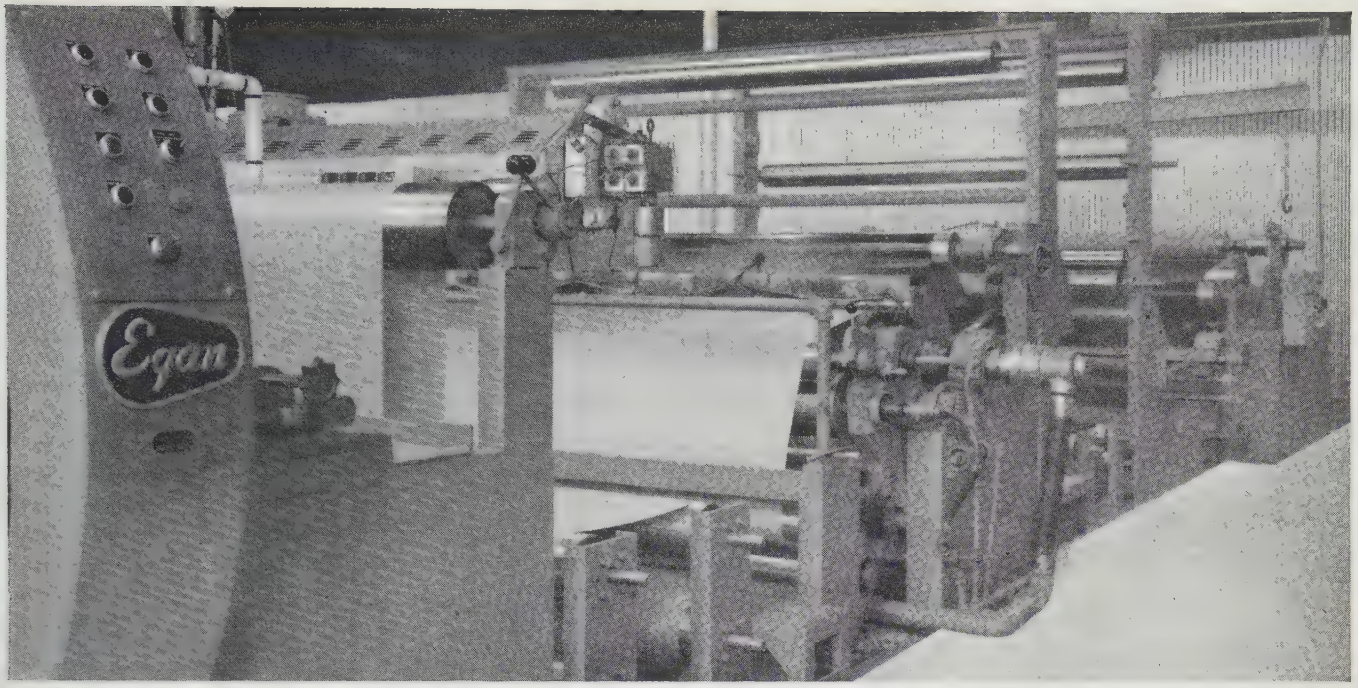

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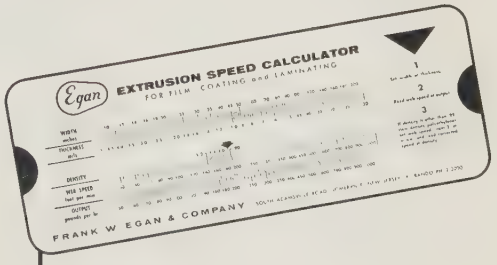

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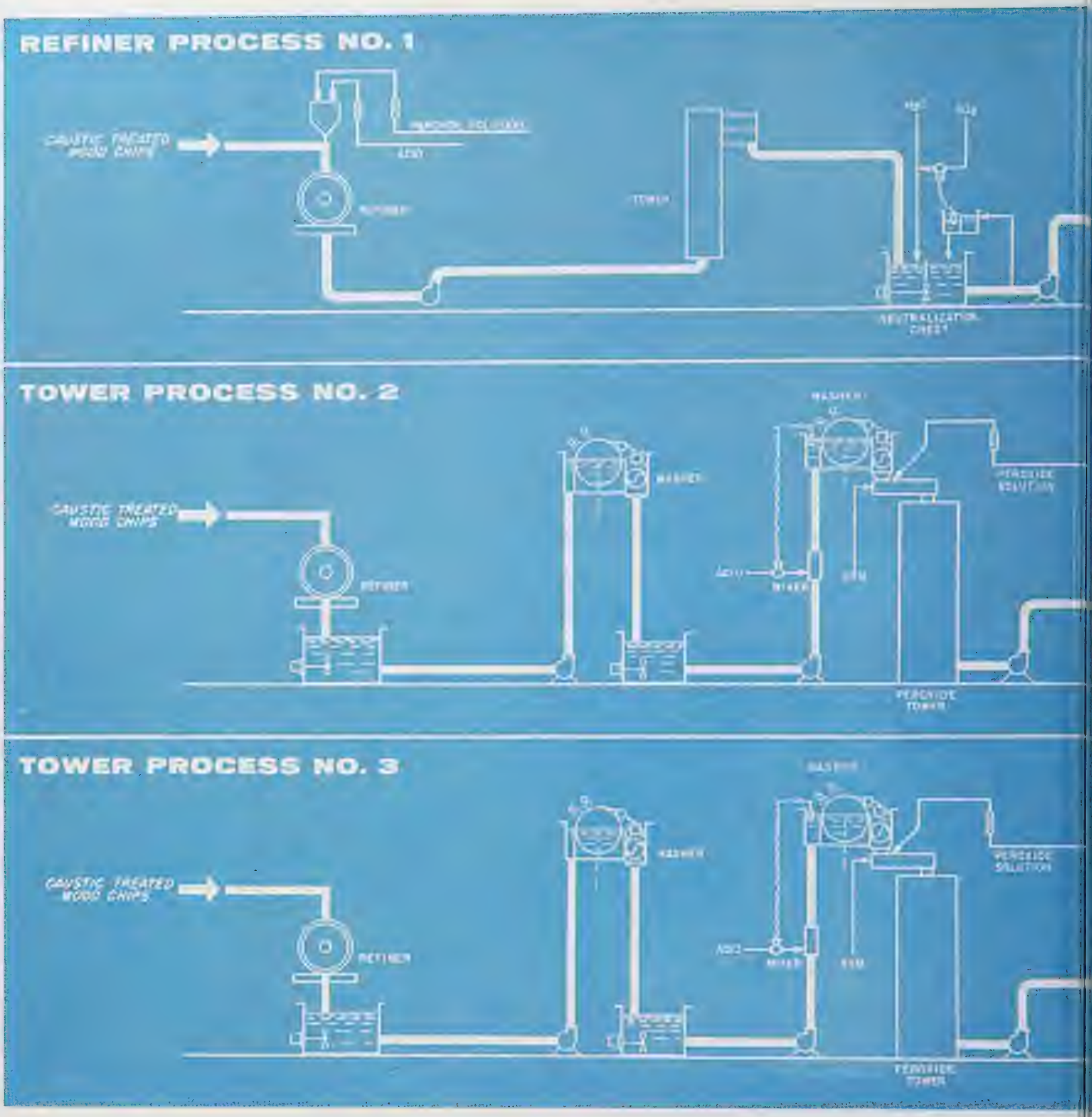

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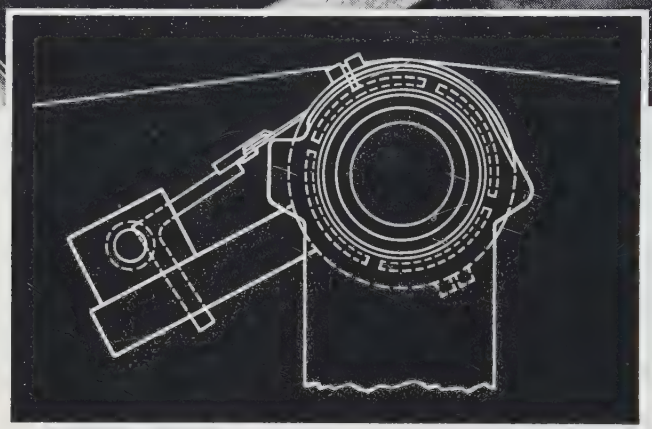

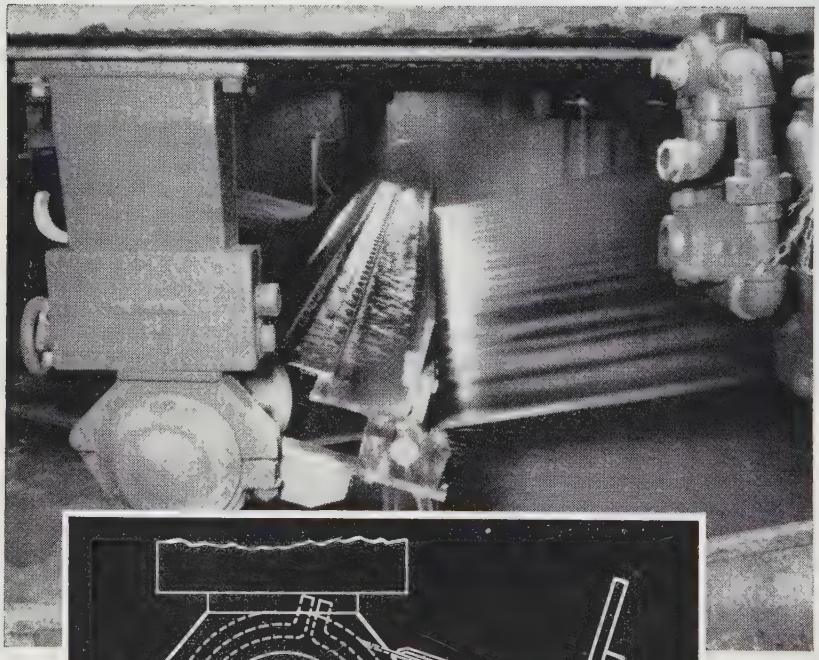

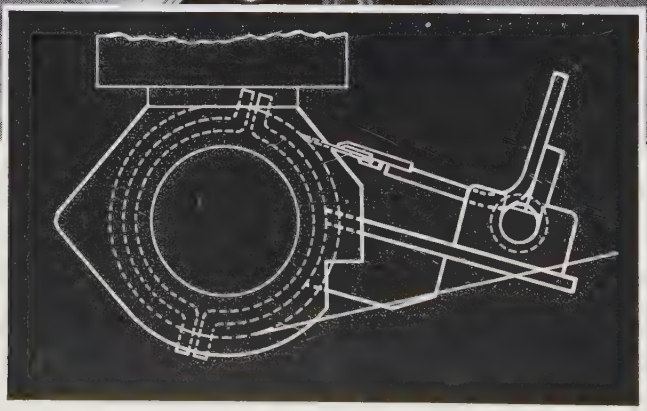

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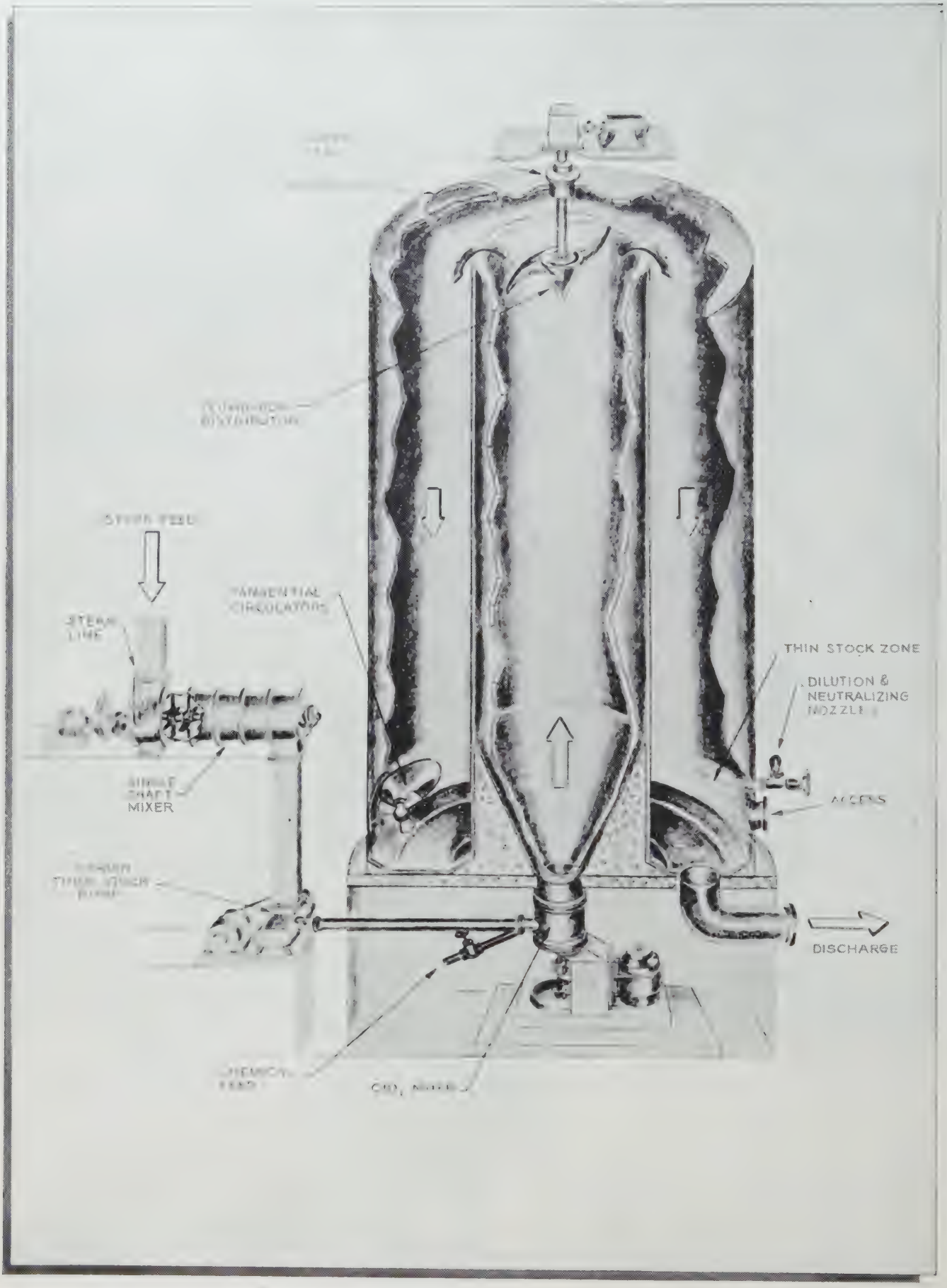
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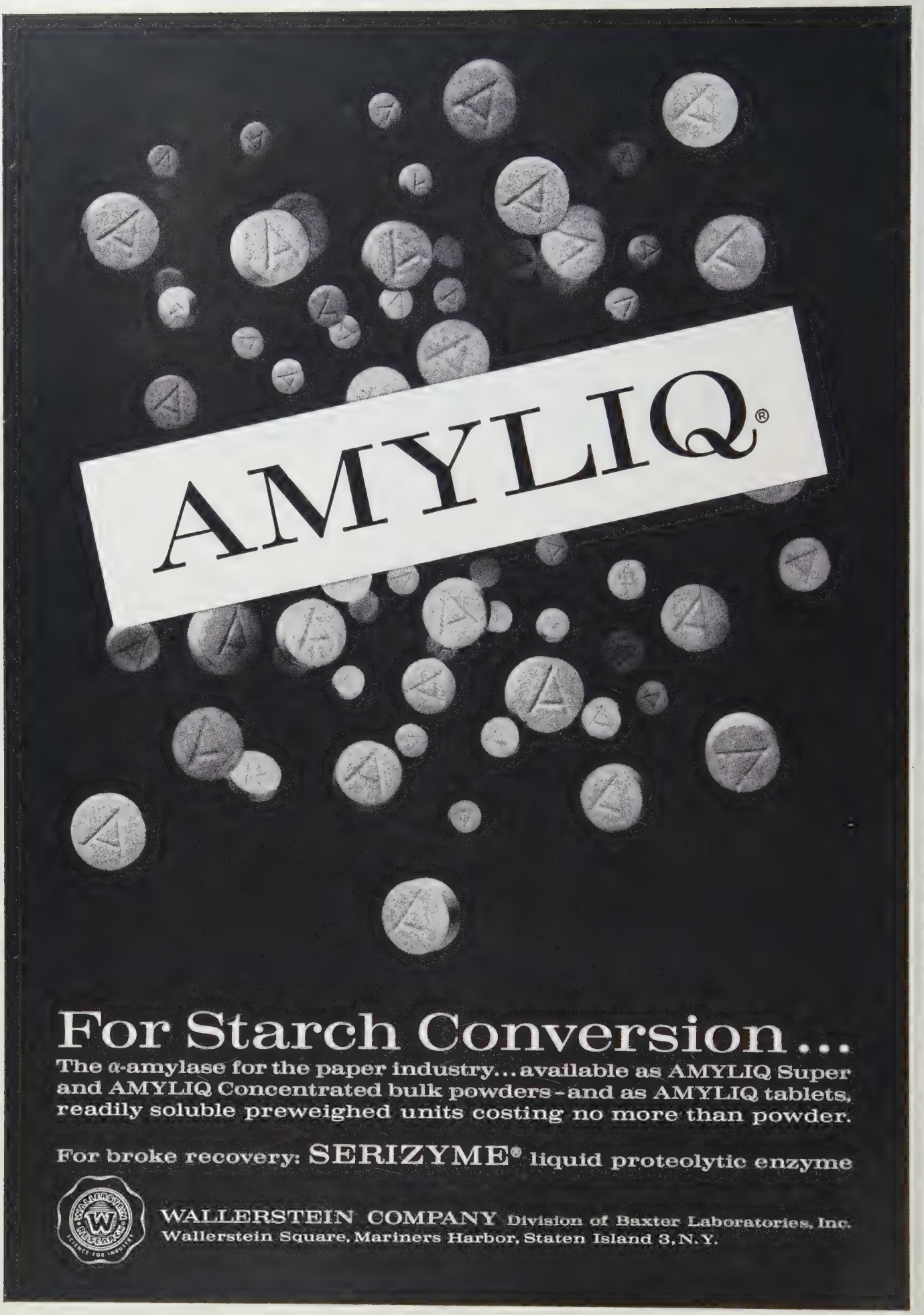

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SYMPOSIUM ON SULFITE PULPING AND RECOVERY SYSTEMS

Proceedings of the 45th Annual Meeting of TAPPI

NEW YORK, N. Y., FEB. 22–25, 1960

Introductory Remarks by Paul J. Frost

As CHAIRMAN of the Acid Sulfite Pulping Committee of TAPPI, I am happy to open this symposium on sulfite pulping and chemical recovery systems.

During the years since World War II, developments relating to sulfite pulping and chemical recovery processes have occurred very rapidly. By this year of 1960, so much progress has been made that our committee concluded that it would be timely to organize and arrange for the presentation and publication of this symposium to provide opportunities for review and discussion of these several significant developments. This has now been done and we hope that you find much new and helpful material presented in the several papers and discussions.

Dr. Joseph L. McCarthy will function as moderator for the symposium. He was graduated from the University of Washington and from McGill University. For several years he served as director of research for the Fraser Companies, Ltd., New Brunswick, Canada. At present he is professor of chemical engineering and dean of the graduate school at the University of Washington. He has been active for many years in the pulp mills research project at the University of Washington as well as on various TAPPI committees and programs. It is with great pleasure that I introduce Dr. McCarthy to you at this time—Dr. McCarthy.

Introductory Remarks by Joseph L. McCarthy

On Nov. 5, 1867, the American chemist, Benjamin Chew Tilghman, was granted United States patent number 70,485 titled "Treating Vegetable Substances for Paper Making." The patent discloses:

". . . the process of treating vegetable substances which contain fibers with a solution of sulfurous acid, in water, with or without the addition of sulfites or other salts of equivalent properties to dissolve the intercellular incrusting or cementing constituent of said vegetable substances so as to leave the undissolved product in a fibrous state, suitable for the manufacture of paper, paper pulp, cellulose, or for other purposes, according to the nature of the material employed . . ."

Tilghman tried to practice his process using calcium as the base but numerous difficulties were experienced.

However, in 1874, in Bergvik, Sweden, the Swedish chemist C. D. Ekman constructed and operated the first sulfite pulp mill and used magnesium as the base. During the next few years, improvements were introduced by the German, A. Mitcherlich, by the Austrians, Eugen Ritter and Carl Kellner, and by others. In the United States, sulfite pulping was first carried out about 1882 by Charles S. Wheelweight who operated the Ekman process using lead-lined cylindrical rotary digesters in a plant situated at East Providence, R. I.

After these beginnings, the technology developed in many ways, and that practiced in the United States and Canada became more or less standardized with calcium as the base used along with the sulfurous acid. In most cases, gymnosperm woods were employed, and particularly the spruce, fir, and hemlock species. The calcium-base sulfite pulping process was widely used without much change or challenge over a period of many years.

Over these years, however, it has become evident that the process has two serious shortcomings: (a) the pulping does not usually proceed well with woods which contain resins in more than small amounts, and (b) the recovery of heat and process chemicals from the spent liquors presents difficulties because of scaling and other problems in evaporation, and of reclaiming the chemicals in easily re-usable form.

For these and other reasons, the last few decades have seen fundamental changes with respect to sulfite pulping chemicals and recovery methods. The trends for United States are indicated by the data given in Table I, which shows the sulfite pulp production capacity for each of the past several decades, newly constructed or obtained by conversion, in the categories of calcium acid sulfite, ammonia acid sulfite, magnesium acid sulfite, and neutral sulfite. Since about 1940 there has been almost no expansion in calcium acid sulfite pulp production and indeed that a very substantial conversion has occurred of facilities to production of ammonia acid sulfite pulp.

Nearly all of the recently constructed acid sulfite pulp mills have been magnesia base systems with complete heat and process chemical recovery arrangements of the type described originally by Tomlinson and Wilcoxson and further developed in recent years. The other substantial expansion which has occurred is in the neutral sulfite pulp production capacity and here solutions of sodium sulfite and carbonate are used under more or less neutral conditions often to produce "high yield" pulps and especially from hardwood species.

Table I. Estimated[a] Sulfite Pulp Production of the United States (Tons/Year)

Year	*Calcium*	*Ammonia*	*Magnesium*	*Total*
1958	. . .	464,400	513,000	. . .
1957	2,449,272	464,400	252,000	3,165,672
1956	2,443,503	572,400	252,000	3,267,902
1955	2,407,379	472,400	216,000	3,095,779
1954	2,342,114	406,800	198,000	2,946,914
1950	2,528,036	230,400	90,000	2,848,436
1946	2,250,000	108,000	000	2,358,000
1940	2,608,000	000	000	2,608,000
1935	1,579,567	000	000	1,579,567
1930	1,567,063	000	000	1,567,063
1925	1,447,191	000	000	1,447,191
1920	1,583,414	000	000	1,583,414
1909	1,179,266	000	000	1,179,266
1899	586,374	000	000	586,374

[a] Estimated from statistical tables and literature by Carter Watson, Technical Director, Puget Sound Pulp and Timber Co., Bellingham, Wash.

PAUL J. FROST, Project Leader, Central Research Department, Crown Zellerbach Corp., Camas, Wash.

JOSEPH L. MCCARTHY, Professor of Chemical Engineering and Dean of the Graduate School, University of Washington, Seattle, Wash.

Table I

	Process			
	Calcium bisulfite		*Magnefite*	
Chemical feed	CaO	S	MgO	S
Chemical makeup, lb./pulp ton	160	220	20	50
Chemical cost, dollars/ton	15.00	35.00	87.00	55.00
Chemical cost, dollars/pulp ton	1.20	3.36	0.87	0.88
Total chemical cost, dollars/pulp ton	5.06	...	1.75	...
Savings in chemical cost: magnefite over CaO = $3.31				

changers thus providing process water at 110°F. for pulp bleaching and washing.

Flue gas at 104°F., containing 1% SO_2 (by volume), flows through two venturi absorbers in serie . At each of these absorption stations $Mg(OH)_2$ slurry is added to the recycled liquor which reacts with the SO_2 to form magnesium bisulfite, $Mg(HSO_3)_2$. Typical product acid from first-stage venturi absorber, when processing magnefite waste liquor, contains 4.7% SO_2 with 2.5% combined SO_2 and 2.2% free SO_2.

By splitting the absorption into stages, pH is separately controlled which optimizes formation of magnesium bisulfite in the first venturi and, by controlling to a higher pH at the second, minimizes loss of SO_2. The control is through regulation of $Mg(OH)_2$ feed to the two absorption venturi stations. High recirculation rate of the slurry favors rapid conversion of $Mg(OH)_2$ through the monosulfite ($MgSO_3$) form to bisulfite. Ninety-five per cent of sulfur in red liquor fired is recovered in the product acid from the venturi absorber.

Sulfur dioxide released during cooking is vented to the absorption system before the cooling tower after cooling in a heat exchanger. This SO_2 recovery technique eliminates the stripping operation at the end of the acid sulfite cook and simplifies the absorption system required for SO_2 recovery. Excess SO_2 from the SO_2 makeup system is also vented to the absorption venturi with the digester relief. The feed of $Mg(OH)_2$ to venturis through pH control assures maximum SO_2 absorption and recovery through variations in SO_2 flow to absorption system.

Raw recovered acid from the first stage venturi then enters the SO_2 makeup system to increase the free SO_2 in the magnefite cooking liquor. Typical acid composition to the digester contains 5.04% total SO_2, with equal combined and free at 2.52% (before dilution from moisture in the wood).

One 400 ton per day magnesium acid sulfite pulp mill reports the chemical makeup at 20 lb. magnesium oxide and 50 lb. sulfur per ton unbleached pulp.

A comparison of chemical costs and savings are given in Table I. A comparison is made between calcium bisulfite without chemical recovery and magnefite with full heat and chemical recovery. The magnefite operation allows a chemical cost saving of $3.31 per ton.

Coincident with chemical recovery, heat value in spent liquor is recovered as steam for power and process. In terms of gross steam per ton of pulp, it is difficult to draw direct comparison owing to influence of process yield, wood species, and grade of pulp. However, due to the lower quantity of base present in magnesium-base pulping, reduced heat of reaction absorbed in reduction of chemicals and increased concentration of liquor from multiple-effect evaporators, thermal efficiency of MgO recovery is approximately 5 to 8% greater than soda base recovery systems.

Gross steam production at pressures up to 1200 p.s.i.g. and 950°F. has exceeded 13,000 lb. per pulp ton in the case of acid sulfite pulp. With magnefite at 50% unbleached yield steam production, 840 p.s.i. and 880°F., would be approximately 11,000 lb. per ton of unbleached pulp. At a steam value of $0.50 per 1000 lb. this would have a value of $5.50 per ton of pulp.

CONCLUSION

The outstanding characteristics of magnesium acid sulfite and magnefite pulping combined with MgO recovery may be summarized as follows:

1. A wide variety of wood species may be pulped by the magnefite process.
2. Pulp of higher yield and greater strength than presently produced by the acid sulfite process may be produced by the magnefite technique.
3. Chemical and semichemical pulps may be produced in conjunction with a single recovery process.
4. Stream and air pollution are eliminated.
5. Heat and chemical recovery are highly efficient.
6. The recovery process is simple and direct without side effects or secondary reactions.
7. The simplicity of the combined MgO cooking and recovery process results in savings of capital, maintenance and operating costs for conversion of existing or construction of new sulfite pulp mills.

LITERATURE CITED

1. Tomlinson, G. H. and Wilcoxson, L. S., "The Economic Disposal of Waste Liquor," Paper Trade Journal, Page 110.
2. Tomlinson, G. H., Tomlinson, F. H., II, Bryce, J. R. G., and Tuck, N. G. M., *Pulp & Paper Magazine of Canada* 60, 247–52 (1959).
3. Welch, L. T., Sheridan, T. G., and Tomlinson, G. H., II, "A Mill Scale Trial Run with the Magnefite Process."
4. Hull, W. Q., Baker, R. E., and Rogers, C. E., Industrial Chemical Engineering 43, 11: 2424–35 (1951).
5. Cronan, C. S., "Magnesia Pulping Breaks Pollution Stalemate," Chemical Engineering 67, No. 18: 60, 62 (Sept. 8, 1958).

Received May 10, 1960. Presented at the 45th Annual Meeting of the Technical Association of the Pulp and Paper Industry, held in New York, N. Y., Feb. 22–25, 1960.

DISCUSSION

Chairman McCarthy: Are there any questions on this paper?

George A. Day (Brown Co. Berlin, N. H.): I have a question to ask. I should like to inquire as to the source of the furnace operating data given in the paper.

Mr. Darmstadt: George, would you like to answer that?

George H. Tomlinson (Howard Smith Paper Mills, Ltd., Cornwall, Ont.): There was a magnefite trial made with full chemical recovery and some of the information was obtained from this trial. This, together with experience on magnesia acid sulfite formed the general background.

Dr. Day: Was that in the fall of 1958?

Dr. Tomlinson: Yes.

Mr. Darmstadt: We must add that the absorption efficiency and data on the venturi was collected on the installation at the Brown Co., at Berlin, N. H., where the absorption venturi system is installed.

The performance that we are predicting is based upon the results at Brown Co., results at Weyerhaeuser, and some predictions into the future.

John H. E. Herbst (Industrial Cellulose Research, Ltd., Haw Kesbury, Ont.): I should like to ask a question about the makeup chemicals.

Why is the magnesium recovery relatively so much better—

in other words, why is the magnesium makeup required so much lower than the sulfur makeup?

Dr. Tomlinson: Actually, we don't have any long-term operating data on magnefite recovery, as was apparent from the answer to the last question. There are acids formed from the wood in the cook, as you know, which in turn react with the bisulfite to form sulfur dioxide, and you are going to have some loss of sulfur independent of the magnesium in the system. We believe that sulfur recovery will be somewhat better than with the acid sulfite process; how much better we do not know because we do not have the experience over a long period of operation. A figure of 50 lb. sulfur makeup should be easily realized, and I would expect it to be better.

I might say, too, that the figure 20 lb. of MgO is nominal. As you know, you can design a mill for a very high efficiency on any system, whether it be kraft or sulfite, and this figure is one that can be obtained with existing equipment and techniques, without any undue cost.

Axel F. Scholander (Mo och Domsjö A.B. Ornskoldsvik, Sweden): I saw that you had quite a closed water system. If you have salt water logs, how do you take out the chloride content in the liquor? Can't you get an accumulation of it? Or, don't you get an accumulation of it?

Mr. Darmstadt: The question has been raised as to what means is used to dispose of or to eliminate the chloride from the liquor system if you have a salt water situation.

I think we can answer it this way: that very little effort actually is made to eliminate the sodium chloride from the system. This is based upon the operating experience at Ketchikan, which has been in service now some 6 years.

The wood at Ketchikan is probably in the water, in sea water, for a minimum of 6 months, and probably averages about 9 months to become saturated with salt water.

The operating experience has shown that the sodium chloride as chloride ion goes in the cooking liquor to the digesters in the order of about 1500 p.p.m.

We can report that although there was some question regarding materials that had to be considered during the initial start at Ketchikan, that these have stabilized and there is no serious corrosion at Ketchikan with the chloride level of 1500 p.p.m. in the cooking liquors. Does that answer your question?

Dr. Scholander: Yes, thank you.

Mr. Darmstadt: Is there anybody from Ketchikan that might want to comment on that?

Dr. Tomlinson has just reminded me that the chloride does reach chemical equilibrium to some degree through the losses going out at stack. Normally, for MgO recovery system on non-salt water borne wood the discharge at the stack is a light water vapor plume.

However, where we have salt water borne wood, there seems to be a plume characteristic perhaps of the kraft operation. It is light and it is sodium chloride. It leaves the system through the stack discharge.

We noted this in our early work, and it is evident at Ketchikan as well. This keeps the level down slightly. Some additional sodium chloride, of course, is washed from the recovered MgO in the washing system, but this is probably in very small amount.

John S. Freeman (Canadian Industries, Ltd.): My question is, is there any special requirement for the purity in the MgO used in the process?

Mr. Darmstadt: I don't think we really know how pure it must be at this point. I think if I were to say anything else, it would be out of order. We try to reduce the calcium and the silica, perhaps the aluminum iron, but I don't think that we really have the answer.

I see Charlie Rogers sitting behind you. Perhaps he might want to comment on that.

Charles Rogers (Babcock & Wilcox Co., New York, N. Y.): No, I have nothing to say about that.

Mr. Darmstadt: We try to minimize the silica and the calcium to prevent scaling in the evaporation. At the present time, I might indicate we are processing on the Swedish installation using magnesium sulfate. We have seen some good magnesium sulfate and some poor magnesium sulfate, and the most favorable material available appears to be from Germany, a by-product from the manufacture of potash, and it is particularly low in silica and calcium.

Bengt G. Rånby (State University College of Forestry, Syracuse, N. Y.): Would you care to repeat the yields of bleached and unbleached pulp you mentioned?

Dr. Tomlinson: This paper was very broad in regard to yields mentioned. In other words you can work in a whole range. We spoke of 90% yields, which are these rather bulky pulps.

Then you can consider the 60 or 70% range, which would be the normal semichemical range. You next consider lower yields around 50 to 55%, which would be the chemical pulp range; actually, chemical pulps can be obtained in yields up to 60% which also has been noted at Syracuse.

Dr. Rånby: Can you give yields for comparison of the magnefite process with the more conventional calcium sulfite process?

Dr. Tomlinson: It was stated that normally you would cook bisulfite pulp to a higher chlorine demand than you would an acid sulfite pulp. Normally, in an acid sulfite mill, the experience with regard to rejects would demand that you cook at, say, a permanganate number up to 14 or a Roe-chlorine number of about 3.

With bisulfite you may operate very much higher, up to a Roe-chlorine number of about 10 or so and still get a chemical pulp, without unduly high rejects, so holding to a low chlorine number is not a critical factor.

Then, the general determination of where you will stop your pulping will be related to the general economics of the value of increased yield and cost of chlorine.

In an earlier paper which was presented at a TAPPI regional meeting at Wausau a year or so ago, we gave an example there of a mill, magnefite pulp, which was obtained at a chlorine number of about 5.4, and that gave a bleached yield of something around 48.6%, which was considerably higher than a bleached yield of 45.6% with conventional acid sulfite to a chlorine number of 3.4. It is possible to go still higher than that and probably would be economical in many locations to do so.

Chairman McCarthy: To what extent is success found in using the magnesia process, or magnefite process, on such species as Douglas-fir?

Dr. Tomlinson: We have done a few experiments on that. It seems possible. There was a paper given at the CPPA meeting in Montreal last month by Wilson and O'Meara. Possibly they are here this morning.

They were cooking mixed species characteristic of both Northern and South Central British Columbia, which includes Douglas-fir, pines, and so on, and they found that these woods gave in fact excellent pulps.

J. J. Voci (Arthur D. Little, Inc.): You went over the thermal efficiency of the magnefite process. You mentioned something like 13,000 lb. of steam for a ton of pulp. Could you give some information on the yield?

Mr. Darmstadt: The figure of 13,000 lb. per ton of pulp does not apply to the magnefite technique. I think we must consider that as magnesia acid sulfite in the lower yield range of probably in the order of about 40 to 41% yield.

For the magnefite, of course, the steam or heat recovery is considerably lower than that because of the higher yield, the lower organic content of the liquor.

I think we must conclude here on this point that each situation must be considered in the light of its own wood and pulp grade. It is very difficult to report in a paper of this type on specific data to cover all situations.

CHAIRMAN MCCARTHY: I think, then, if there are no further questions at this time we will proceed to the next paper. However, I suggest that at the end of the morning we will endeavor to get the respective authors up before you again for a while for an additional period of comments and questions about the papers presented this morning.

Thank you, Mr. Darmstadt and you, Dr. Tomlinson. We appreciate very much your excellent presentation.

The next paper is on "Chemical Recovery from Sulfite Spent Liquors by the Atomized Suspension Technique," to be presented by Dr. W. H. Gauvin of the Pulp and Paper Institute, McGill University, Montreal, Que.

Chemical Recovery from Sulfite Spent Liquors by the Atomized Suspension Technique

W. H. GAUVIN and J. J. O. GRAVEL

Pyrolysis of NSSC spent liquors under reducing conditions yields a solid product consisting essentially of sodium carbonate, with small amounts of sodium sulfate (usually less than originally present in the liquor). Combustible gases of good calorific value are also produced from which the sulfur can be recovered as SO_2. A brief review of recent investigations of the engineering aspects of the technique is presented. A corrosion study has shown that austenitic stainless steels are strongly attacked when in contact with sodium carbonate or sulfate in a fused condition. Experimental data both below and above the fusion point of these salts (765°C.) and for a wide range of residence times are given. A feed concentration of 55% and reactor pressures in the range 0–60 p.s.i.g. were used. The results indicate that adequate sodium carbonate conversions can be obtained at wall temperatures below the fusion point.

PREVIOUS investigations have shown the feasibility of recovering sodium salts in the form of sodium carbonate from neutral sodium sulfite semichemical spent liquors (*1*) and from acid sodium sulfite liquors (*2*), by means of the atomized suspension technique (AST). These preliminary studies were concerned primarily with the chemical aspects of the process; the results obtained were encouraging since they indicated that sodium carbonate could be recovered in yields of 90% and higher, with appreciable reduction of the sodium sulfate initially present in the black liquor, and without formation of undesirable sodium compounds such as sodium sulfide or thiosulfate.

Since these studies were first published, efforts have been concentrated on the engineering aspects of the process. Although most of the auxiliary equipment shown in the proposed flowsheets (*1*, *2*) is of conventional design (such as evaporators, cyclone separators, scrubbers, and sulfiting towers), it should be emphasized that in the operation of an atomized suspension reactor itself there are many complex phenomena which have never been investigated before, particularly at the temperature levels involved. Chief among these are the gas flow patterns, particle trajectory and transfer rates—both for heat and mass transfer. In addition, materials of construction require special attention since the experience acquired with conventional methods is of little assistance in predicting the behavior of various metals under these new conditions.

W. H. GAUVIN, Head, Chemical Engineering Division, Pulp and Paper Research Institute of Canada, Montreal, P. Q.; J. J. O. GRAVEL, Chief, Reactor Group, Pulp and Paper Research Institute of Canada, Montreal, P. Q.

The following is a brief summary of the studies already completed or currently in progress which deal directly or indirectly with these problems.

FUNDAMENTAL STUDIES

The behavior of droplets decelerating in an atomized spray has been studied and their velocities measured by means of high-speed cinematographic methods (*3*). A thorough analysis of the published information on solids-gas flow has recently been completed and some measurements of the motion of droplets or particles as a function of the turbulence parameters of the entraining fluid have been reported (*4*). A detailed study of the velocity profiles and flow patterns of gases or vapors flowing under the conditions encountered in an atomized suspension reactor is currently under way. From a heat transfer point of view, the rate of evaporation of droplets—both stationary and in the form of a cloud—in high-temperature surroundings has been measured (*5*), but the study is continuing in an attempt to simplify the complex methods of calculation which were developed. Useful information has also been obtained on more general aspects of the behavior of droplets and particles during evaporation and drying (*6*, *7*). An interesting study in chemical kinetics, the purpose of which is to predict the very high reaction rates which have been found possible in suspended systems, is also nearing completion.

DEVELOPMENT WORK

Since the atomized suspension technique is in essence a new method of effecting physical and chemical changes in suitably subdivided materials, a great deal of the experience acquired from the study of a given system can be used to predict the behavior of another, in spite of the fact that the latter might be quite different. Although this technique is a newcomer to the field of chemical recovery from spent pulping liquors, it is expected that its progress will be rather rapid once experience with the operation of a few commercial or semicommercial installations becomes available. Such information is already being acquired with a small sewage sludge disposal plant which has been in operation at the town of Beaconsfield, Quebec, since August, 1959. A report summarizing its technical and operational aspects has been presented recently (*8*). Larger plants for other applications of AST are currently being

erected, two of which should be in operation in the near future.

MATERIALS OF CONSTRUCTION

Most of the applications which are currently being studied in the nine AST experimental pilot plants (two in Scotland, two in the United States, and five in Canada) do not appear to involve corrosion problems, although austenitic stainless steel construction is in every case required for strength at high temperatures. When sodium carbonate and/or sodium sulfate are present, however, severe corrosion can be expected if these salts are allowed to accumulate in a fused condition on stainless steel surfaces. Metallurgical examination of the walls of an 8-in. i.d., 10-ft. high reactor operated on NSSC black liquors by the Green Bay Paper and Pulp Co. for a few hundred hours confirmed that austenitic stainless steels such as 316 and 309 are very severely attacked by fused sodium carbonate or sodium sulfate in the presence of an atmosphere rich in H_2S. Wall deposits may occur in the turbulent region of the atomizing nozzle and can be appreciable under faulty conditions, i.e., in the case of poor atomization or wrong positioning of the nozzle. They may also occur when the particle flow pattern is altered and should be less likely to take place in large commercial reactors than in narrow-diameter experimental tubes. Although mechanical means could be devised to prevent wall contacts, it is evident that the materials of construction for a commercial reactor should be selected to provide adequate protection against the eventuality of corrosion.

Tests in small muffle furnaces, operated over a temperature range of from 650 to 850°C. and in atmospheres which closely simulate those prevailing in an atomized suspension reactor during the processing of spent sulfite liquors, have shown that the corrosion rates resulting from exposure to the gas phase are acceptable. When covered with fused sodium salts, alumina, aluminized ceramics and aluminized stainless steels were found to exhibit corrosion resistance, as long as the protective coat remained unimpaired. Fortunately, the aluminizing procedure is simple enough so that it can be used in the field, either for initial application or for repair. At lower temperatures, below the fusion point of the sodium salts, the corrosion rates were too small to be measured.

The present paper describes an investigation undertaken to determine the range of operating conditions, compatible with good sodium carbonate recovery, within which little or no corrosion would be encountered from the solid-phase products.

EXPERIMENTAL

Apparatus

A detailed description of the experimental apparatus has been given in references (*1* and *2*). The equipment used in the present study was basically the same and consisted of an 8-in. i.d., 10-ft. high electrically heated reactor tube, feed tanks, cyclone separators, pressure control valve, and condenser. However, a number of improvements were introduced, notably the addition of a preheater on the spent liquor feed line. By this means the temperature of the concentrated liquor (55% solids) could be increased and its viscosity reduced, thereby improving the atomization. It consisted essentially of two concentric copper tubes in which the waste liquor passed through the inner tube, while saturated steam condensed in the annulus. The gas scrubbers and bag filter were not used in the present study and the gas holder was replaced by a wet test meter. Finally, the reactor bottom cone and the first cyclone were both electrically heated to assist in the collection of the dry solid product.

A spraying system pneumatic-atomizing nozzle (Model no. 12) was used for most of the work. The nozzle body was modified to include thermocouples to measure both the feed and the atomizing steam temperatures and a pressure tap to measure the atomizing steam pressure, directly at the nozzle. In this way, the atomizing conditions were known more accurately than previously. For the final run, a Delavan pressure nozzle (WDA-1.0-SS-30°) was employed.

Procedure

The reactor tube was brought up to the operating temperature and then water was fed through the nozzle to warm up the cyclones and associated lines, with the pressure controller set to maintain a predetermined operating pressure. When conditions had become completely steady, the changeover from water to liquor feed was effected. After a further brief period to allow steady-state to be re-established, the run proper was started. Samples of condensate, solid residue, and pyrolysis gas were taken for analysis, the rates of condensate collection and gas evolution were measured, and the various readings of pressure and temperature were recorded. A close check was at all times maintained on the feed rate, the feed temperature, and on the atomizing steam pressure to control the degree of atomization accurately. Upon completion of the test, the liquor feed was stopped but the atomizing steam was allowed to continue for 15 min. to purge the pyrolysis gas from the system. The reactor pressure was then relieved slowly and, after further purging, the atomizing steam was stopped, the nozzle removed and the reactor allowed to cool overnight. The reactor top was removed the next morning and the walls examined for the presence of any deposit.

Methods of Chemical Analyses

Feed Liquor. The total sodium and total calcium contents were determined by conventional flame spectrophotometry. Analyses for the sulfur compounds of sodium were carried out according to TAPPI Standard Methods T 624, T 625, and T 629 while total sulfur was determined in a LECO furnace. Carbonate content was measured by acidification with hydrochloric acid followed by distillation and absorption of the resulting carbon dioxide in ascarite. The calorific value of the feed solids was determined in a Parr bomb using sodium peroxide as the oxidant. The measurement of pH was carried out directly using a glass electrode.

Solid Product. Carbonate content was determined as in the feed liquor. Sulfur compounds of sodium were analyzed in total as sodium sulfate after oxidation of the reduced sulfur compounds (e.g., sodium sulfide) to the sulfate, using bromine-nitric acid solution. The resulting total sulfate was precipitated as barium sulfate and determined gravimetrically.

Table I. Feed Properties

Total solids, wt. %	55.5
Density at 25°C., g./cc.	1.295
pH at 20°C.	6.6 ± 0.2
Calorific value of solids, B.t.u./lb.	4260
Total sodium, Wt. % of total solids	13.5
Total sulfur, Wt. % of total solids	8.12
Total calcium, Wt. % of total solids	<0.05
Sodium sulfate, Wt. % of total solids	5.95
Sodium sulfide, Wt. % of total solids	0.02
Sodium sulfite, Wt. % of total solids	Nil
Sodium thiosulfate, Wt. % of total solids	0.42
Sodium carbonate, Wt. % of total solids	0.96

Gases. Hydrogen sulfide was absorbed in anhydrous cupric sulfate while sulfur dioxide was oxidized to the trioxide by hydrogen peroxide and measured by titration. The remaining components were determined in a Burrell gas analyzer using standard solutions. (A full gas analysis was performed on only two runs to check the average molecular weight of the pyrolysis gas.)

Feed Properties

The neutral sulfite spent liquor used in this study was obtained in a concentrated form (55% solids) from the Green Bay Paper and Pulp Co. of Green Bay, Wis. Its properties are summarized in Table I. It was somewhat different from the spent liquor used in the previous work (*1*); in particular, its thiosulfate and sulfide contents were appreciably lower, and so was the calorific value of the dry solids. Crystalline solids did not separate out of the concentrated liquor even at temperatures as low as 40°F. Furthermore, a screening of the spent liquor showed that it contained a negligible amount of only very short fibers. Consequently, no difficulties were experienced with liquor handling, pumping or atomizing, even with the Delavan pressure nozzle whose orifice is only 400 μ (0.015 in.) in diameter. The pH of the present liquor is seen to be very slightly on the acid side which runs contrary to the general behavior; all of which only serves to stress the fact that NSSC spent liquors "may be expected to exhibit a wide range of physical and chemical characteristics" (*9*). On the other hand, the density of the 55% spent liquor agreed quite well with reported density values (*9*).

EXPERIMENTAL RESULTS AND OBSERVATIONS

A total of 16 runs were performed in this investigation, the first four of which were of a preliminary nature to find the optimum operating conditions, with particular emphasis on atomization, and are not reported here. The operating conditions and experimental results for the twelve remaining tests are summarized in Table II. It should be noted that the last run (no. 293) was performed with a pressure nozzle, whereas in the others, a pneumatic atomizer was employed. Although the liquor concentration was much higher than in the previous work, good atomization was obtained in all cases as a result of feed preheating. The duration of each run was normally one hour, and low feed rates were deliberately used to make the residence time or more specifically the time available for reaction, as long as possible.

The main operating variables studied were: reactor wall temperature (700–800°C.), reactor pressure (0–60 p.s.i.g.), and residence time (16–126 sec.). However, the latter two quantities are not wholly independent of each other since, with the other pertinent variables remaining constant, the residence time is a function of the reactor pressure. It should be pointed out that the residence time, as estimated in this work, is somewhat arbitrary and can only be used as an approximate guide when comparing widely different conditions. It is defined as the ratio of the reactor volume to the volumetric flow rate of the reactor outlet vapors, based upon the outlet conditions of temperature, pressure, and flow rate. Consequently, it does not take into account variations in velocity profile, in vapor temperature along the length of the reactor, or in vapor flow rate as evaporation proceeds. However, in spite of these limitations, it is probably quite accurate when used as a basis of relative comparison between different runs on the same feed material using the same nozzle.

The solid product was, in practically all cases, a free flowing, uniform powder with a gray to gray-black color. The individual particles ranged in diameter between 10 and 30 μ for the reactor cone product, and between 5 and 20 μ for the first cyclone product.

Table II. Operating Conditions and Results

	Run no. 282	283	284	285	286	287	288	289	290	291	292	293
Operating Conditions												
Reactor wall temperature, °C.	750	750	700	700	700	750	750	800	750/800	700/775	775	750
Reactor pressure, p.s.i.g.	0	30	30	60	60	60	60	30	30	30	30	30
Outlet vapor temperature, °C.	500	540	475	470	450	515	500	550	530	515	505	420
Feed liquor rate, lb./hr.	10.7	12.4	12.7	12.1	6.4	13.3	6.5	13.6	12.0	15.0	13.8	13.8
Feed liquor temperature, °C.	90	108	100	128	128	110	120	110	120	115	120	132
Residence time, sec.	16	40	52	77	126	65	100	36	38	36	39	86
Product Yields												
Feed solids rate, lb./hr.	6.0	7.0	7.1	6.8	3.6	7.5	3.8	7.5	6.7	8.2	7.7	7.7
Condensate rate, lb./hr.	10.6	12.3	11.3	13.0	8.1	13.2	9.3	12.2	12.4	14.2	12.4	5.5
Pyrolysis gas rate, cu. ft/min. lb./hr. (estd.)	1.45	1.46	0.88	0.89	0.55	1.47	0.79	1.96	1.79	1.61	1.80	1.21
	4.7	4.9	3.3	3.3	1.9	5.0	2.7	6.1	5.4	5.5	5.8	3.8
Pyrolysis gas yield, wt. % of feed solids	78	70	46	48	54	67	71	81	81	67	76	49
Solid residue yield, wt. % of feed solids	36.1	35.4	46.0	45.0	46.4	37.5	34.1	31.8	32.3	37.9	33.6	40.8
Total yield, wt. % of feed solids	114	105	92	93	100	105	105	113	113	105	110	90
Chemical Analysis of Solid Residue												
Sodium carbonate, wt. %	76.2	78.6	55.4	57.0	58.2	73.6	83.4	91.7	89.5	72.0	84.0	67.8
Sodium sulfate, wt. %	13.2	12.0	15.9	15.9	11.9	12.4	10.5	7.9	9.2	13.2	11.3	11.4
Sodium as sodium carbonate, wt. % of total sodium	88.5	89.7	82.2	83.0	86.6	88.9	91.2	93.9	92.8	88.2	90.8	88.8

Usually, a greater proportion of the total product was removed from the first cyclone than from the cone. Only a very small amount of material was obtained from the second cyclone in most runs and, since no bag filter was used, the fines were removed from the system with the condensate. However, only in the last run, where the vapor velocity in the lines was low due to the use of a pressure nozzle (since no atomizing steam was used), was the proportion of condensate fines excessive. (This sort of occurrence is frequently encountered in a pilot plant which is called upon to operate over a fairly wide range of conditions. In a commercial plant, much greater efficiencies would be realized by designing for a specific set of operating conditions and vapor velocity.)

The solid product was on occasions pyrophoric and was stored in nitrogen-filled containers. A microscopic examination showed that the particles were porous and roughly spherical with some agglomeration, probably due to a slight degree of hygroscopicity. A typical product analysis is given in Table III (run no. 292).

Several careful determinations of the fusion point of the various solid products obtained were carried out in a muffle furnace and a minimum value of 765°C. was observed.

The condensate was usually a light green color and slightly turbid due to the presence of residual fines which escaped the cyclone collectors. A typical gas analysis is shown in Table IV (run no. 292).

Contact of the droplets with the wall is extremely difficult to avoid in the vicinity of the atomizing nozzle, particularly in a reactor tube with a diameter of only 8 in. As a result, wall deposits were usually observed in the upper 3 ft. of the reactor when the top was removed. Their nature varied widely with the wall temperature used in the particular test during which they were produced. At wall temperatures of 750°C. and lower (i.e., below the fusion point of the salts) they were thin, light, and fluffy and crumbled at the slightest contact. It is doubtful whether they would have the mechanical strength to build up to an appreciable thickness during continuous operation, and could probably be dislodged with a small amount of vibration. At higher wall temperatures (775 and 800°C.), however, they became denser, glassy in appearance and strongly adherent, and gave every evidence of having been deposited in a fused condition. As mentioned earlier, the latter type of wall deposit is conducive to high rates of corrosion on unprotected austenitic stainless steels.

DISCUSSION OF RESULTS

In the earlier study (*1*), the recovery of sodium carbonate was investigated at two temperatures (650 and 750°C.) and over a narrow range of residence time (16.2 to 19.2 sec.). One of the tasks of the present work was to extend the range of operating conditions in an attempt to evaluate the individual effects of temperature and residence time, respectively, on the chemical recovery. As shown in Fig. 1, the results indicate that the wall temperature has a far greater effect on the extent of conversion than the residence time. Even when increased to values of 50 sec. and over, the latter does not give more than a marginal gain in conversion. It appears, therefore, that, in practice, operation at residence times of slightly less than 20 sec. would be satisfactory, as suggested in the earlier work.

Table III. Analysis of Solid Product

(Run no. 292)

Sodium carbonate, wt. %	84.0
Sodium sulfate, wt. %	5.75
Sodium sulfate (after total oxidation of S), wt. %	11.3
Ash (at 800°C.) wt. %	92.8
Material insoluble in hydrochloric acid, wt. %	2.9
Sodium as sodium carbonate, wt. % of total sodium	90.8

Table IV. Analysis of Pyrolysis Gas

(Run no. 292)

Hydrogen sulfide, % by vol.	1.5
Sulfur dioxide, % by vol.	Nil
Carbon dioxide, % by vol.	32.2
Illuminants, % by vol.	1.4
Oxygen, % by vol.	1.0
Hydrogen, % by vol.	44.3
Carbon monoxide, % by vol.	3.1
Paraffins, % by vol.	7.0
Inert (assumed nitrogen), % by vol.	9.5

No significant departure from the general behavior shown in Fig. 1 could be ascribed to the use of higher reactor pressures (runs no. 285, 286, 287, 288) or to that of a different atomizing nozzle (run no. 293). On the other hand, comparison with the earlier work seems to indicate that the organic content of the feed liquor solids, as reflected by their calorific value, affects the conversion somewhat. At a given temperature and residence time, the conversion obtained with the present liquor (4260 B.t.u./lb. of solids) was slightly lower than that obtained with the previous liquor (4940 B.t.u./lb. of solids). Still higher conversions were observed with the sodium-base spent sulfite liquor used in reference (*2*) (7700 B.t.u./lb. of solids, average).

Figure 2 shows the variation in yield of products (solids, gas, and total) as a function of temperature, at a constant extrapolated residence time of 40 sec. As expected, the yield of solid product decreases at first rapidly with an increase in temperature, while that of the pyrolysis gas increases. As thermal decomposition approaches completeness at higher temperatures, both yields are seen to tend toward asymptotic values. The large increase in gas production at temperatures of 750°C. and higher reflects the onset of steam decomposition in the presence of the carbonaceous materials in the solid particles. The occurrence of this reaction

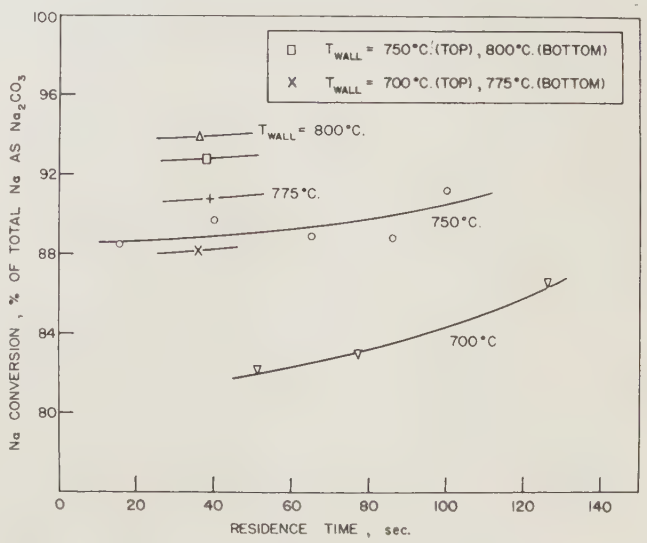

Fig. 1. Effects of temperature and residence time on the sodium conversion

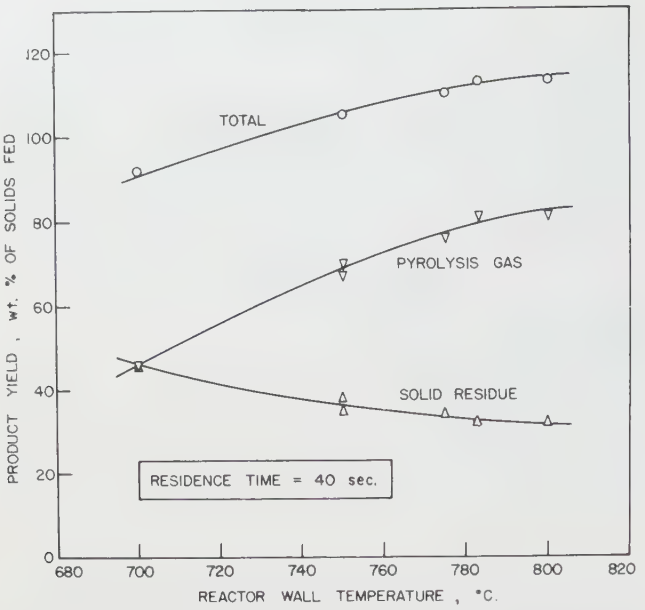

Fig. 2. Product yield as a function of temperature

under the conditions prevailing in an atomized suspension reactor has been discussed in detail in a previous paper (*2*).

The analysis of the solid product from run no. 292, shown in Table III, seems to indicate the presence of small amounts of a sulfur compound which is probably in the form of an organic sulfide. It is doubtful whether it is present as sodium sulfide, since the latter would be expected to be decomposed easily in the reactor in the presence of steam. As in the earlier work, no sodium sulfite or thiosulfate were observed. Table IV indicates no significant departure from the chemical composition previously reported for the pyrolysis gas, with the possible exception of a lower H_2S content, which probably results partially from the lower sulfur content in the feed (more particularly from its low sodium thiosulfate and sulfide contents), and partially from the sulfur content of the product, as mentioned above.

CONCLUSIONS

The experimental work which has just been presented confirms the earlier findings, while providing data over a much wider range of operating conditions and for a higher feed concentration (55%). Excellent atomization was shown to be possible if the latter was preheated to a temperature of 100°C. or over.

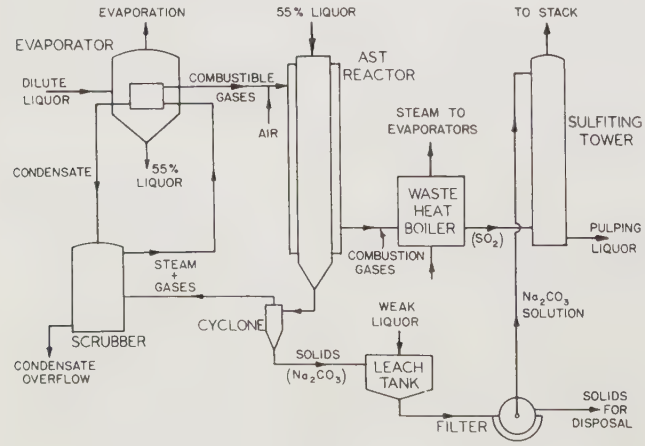

Fig. 3. Process flowsheet for sodium carbonate recovery from NSSC liquors

Although the use of high temperatures is desirable from the point of view of heat transfer and of sodium carbonate conversion, the possibility of wall corrosion in the presence of fused sodium carbonate or sulfate was shown to limit the wall temperature to a level below the fusion point of these salts (765°C. in the present work). For the liquor used, at a wall temperature of 750°C. and with a residence time of 15 to 20 sec., Fig. 1 indicates that a conversion of 89% might be expected. This value seems to be still high enough to form a reasonable basis for a commercial process. A simplified flow sheet for such a process is shown in Fig. 3. Comparison with earlier work (*1*, *2*) would indicate that conversion will improve if the organic content of the feed liquor is increased.

Operation at higher temperatures is still possible with austenitic stainless steels if adequate protection is provided. Aluminizing of the metal surfaces has been shown to provide adequate protection, but the life of the protective coating as a function of its thickness and of the environment conditions still remains to be determined. Alternatively, new superalloys or ceramic materials with the desired corrosion resistance might eventually be found. Until such time, however, it is more realistic to consider operation within the safe temperature range determined in this investigation.

LITERATURE CITED

1. Lee, G., and Gauvin, W. H., *Tappi* 41, No. 3: 110 (1958).
2. Lee, G., Themelis, N. J., and Gauvin, W. H., *Tappi* 41, No. 6: 312 (1958); *ibid.*, *Pulp and Paper Mag. Can.* 59, No. 3: 140 (1958).
3. Manning, W. P. and Gauvin, W. H., *A. I. Ch. E. J.* (in press).
4. Torobin, L. B., Ph.D. Thesis, McGill University (1960).
5. Hoffman, T. W., Ph.D. Thesis, McGill University (1959).
6. Dlouhy, J. and Gauvin, W. H., *A. I. Ch. E. J.*, 6: 29 (1960).
7. Pasternak, I. S. and Gauvin, W. H., *Can. J. Chem. Eng.*, 38: 35 (1960).
8. Gauvin, W. H., Kingston, J. E., and Inglis, D. Presented at the Symposium on Industrial Wastes, Meeting of the American Chemical Society, Cleveland, Ohio, April 11, 1960.
9. Han, S. T., *Tappi* 40, No. 11: 921 (1957).

Received May 10, 1960. Presented at the 45th Annual Meeting of the Technical Association of the Pulp and Paper Industry, held in New York, N. Y., Feb. 22–25, 1960.

The collaboration of Hugh Barclay in the conduct of the experimental work and the evaluation of the results is gratefully acknowledged. Recognition is also due to P. Spira, E. T. Bloch, and G. Seibel for their assistance in the physical and chemical determinations and analyses.

DISCUSSION

Chairman McCarthy: Thank you very much, Dr. Gauvin! Who would like to ask the first question? May I ask it, then? Tell us, Dr. Gauvin, for a 350-ton per day sulfite pulp mill for example, what is the cross-sectional area of the reactor which you think would be appropriate?

Dr. Gauvin: We visualize about 3 ft. in diameter for each reactor but a battery of such reactors in parallel will be required. In this case I would say that five units, very likely around 65 ft. high, would be necessary.

Chairman McCarthy: Did I understand that rightly? The individual reactors would be about 3 ft. in diam. each, about 65 ft. high? How many?

Dr. Gauvin: For 350 tons, about five.

Chairman McCarthy: And what would be the per cent solids in the liquor going into the system?

Dr. Gauvin: Around 50 to 60%.

John H. E. Herbst (Industrial Cellulose Research, Ltd.): What, in your opinion, are the main features which make this type of process more desirable than conventional processes?

DR. GAUVIN: That is a pointed question, but I must say, an excellent one.

I am a strong believer in the new technology I have described. Strong trends toward the handling and processing of finely divided matter in transported systems are evident in an increasing number of areas and the latter are beginning to displace some of the less efficient of our conventional methods. More applications will come into use as the present equipment becomes fully amortized or requires replacement.

I think that one of the main advantages of our method will be a reduced capital plant cost. I know that a number of plant cost assessments have already been prepared by several independent equipment manufacturers on a variety of applications, and that in every case the AST plant and equipment costs were appreciably lower than those of more conventional methods.

From an operating point of view, the simplicity of control and operation is also a decided advantage.

DR. SCHOLANDER: Why don't you use instead of five 3-ft. diam. units, two 5-ft. units?

DR. GAUVIN: There are many reasons for this. The first one is that we realize that since our findings still are largely experimental, it is advantageous to give a large mill the option of building one reactor, testing it at their leisure, and if proved satisfactory, to let them add the other two, three, or four reactors needed to handle the full mill capacity.

The second reason is a purely financial one. It is cheaper to have a number of smaller units rather than a single large one, since we are operating under pressure in order to make the recovered steam available for further use. The walls of the single reactor would be unduly thick.

The third reason is that with diameters larger than 5 or 10 ft., there would be a decrease in the rate of radiant heat transfer from the walls, with a resulting loss in capacity.

CHAIRMAN MCCARTHY: Thank you. I would like to express thanks to Dr. Gauvin for his most interesting presentation.

We have this morning on additional paper concerned with the Sivola process, which is one of much interest, operating in Finland today on a substantial scale, and this process will be reviewed by E. H. Kennedy of Combustion Engineering in New York.

The Sivola Sodium-Base Pulping and Chemical Recovery Process

E. H. KENNEDY

This paper presents a short review of the Sivola sulfite recovery process presented a year ago, and will bring the industry up to date on what has developed since then. This matter includes a summary of two-stage plant-digester cooks, made since then, on western hemlock and red fir and on Wisconsin poplar. Also reviewed are the results of laboratory digester cooks being made at the Forest Products Research Laboratory on oak and pine by three different types of pulping, and of laboratory-digester cooks made by a paper mill research laboratory on oak, pine, birch, and poplar by the sodium bisulfite-liquid sulfur dioxide pulping process.

THE DETAILS of the Sivola cooking and recovery process for sulfite digestions were first presented at the Alkaline Pulping Conference, in September, 1958.* To refresh your memory, simplified flow diagrams of the recovery or conversion process are included here. Figure 1, shows that for the two-stage ($NaHSO_3$ + Na_2CO_3) digestions, and Fig. 2, for the single-stage NSSC digestion.

Another type of two-stage cooking to which the Sivola conversion process may be applied is sodium bisulfite in the first stage plus liquid sulfur dioxide in the second stage. Liquid SO_2 can be simply and economically prepared by steam stripping a sodium bisulfite solution containing an excess of real free SO_2. Vapors from the stripping tower are cooled in two stages by water, resulting in relatively pure liquid SO_2 after the last stage. Figure 3, shows a simplified flow diagram of the equipment for producing the liquid SO_2.

The cooking process would use a solution of sodium bisulfite at a pH of about 4.0 and of a proper strength to supply about 6% Na_2O based on dry wood for the first cooking stage. The second cooking stage continues after the injection of liquid SO_2 in the digester in sufficient quantity to bring the pH value down to about 2.0.

Certain advantages would result from using two acid stages of cooking:

1. Cover-to-cover time could probably be reduced from 8 to 6 hr.
2. Since the cook is on the acid side in both stages, present sulfite digesters would not have to be relined unless a third short alkaline stage was used to increase the tear quality.
3. Any kind of wood can be used, including pine.
4. Less steam would be used in cooking.
5. Softer pulps can be made, hence a lower bleach cost.
6. Less base chemical is needed in pulping.
7. Less makeup chemical required.

Table I. Two-Stage Laboratory Cooks

Pulping process	*Wood species*	*Permanganate no.*	*Screen yield, %*	*Rejects, %*	*Total yield, %*
$NaHSO_3$ + liquid SO_2	Birch	11.5	49.4	0.1	49.5
		14.9	51.9	0.1	52.0
		19.2	54.4	0.1	54.5
		11.1	51.6	0.5	52.1
$NaHSO_3$ + liquid SO_2	Aspen	16.0	54.1	0.6	54.7
		16.8	54.8	0.1	55.8
		21.6	56.7	1.5	58.2
$NaHSO_3$ + liquid SO_2	Jack pine	12.3	43.8	4.4	48.2
		13.8	42.3	2.1	44.4
		22.2	46.4	4.4	50.8
		18.0	49.6	0.2	49.8
$NaHSO_3$ + liquid SO_2	Mixed oaks	13.4	43.2	0.8	44.0
$NaHSO_3$ + liquid SO_2	Western hemlock	18.0	47.5	0.7	48.2
$NaHSO_3$ + liquid SO_2	Northern spruce	7.0	46.9	2.6	49.5
		6.0	45.3	5.0	50.3
		5.0	42.3	4.0	46.3
		5.8	47.0	1.3	48.3
		5.4	46.0	0.9	46.9
		6.0	48.1	4.4	52.5

E. H. KENNEDY, Chemical Engineer, Paper Mill Equipment Engineering Combustion Engineering, Inc., New York, N. Y.

* See *Tappi* 42, No. 4: 265 (Apr., 1959).

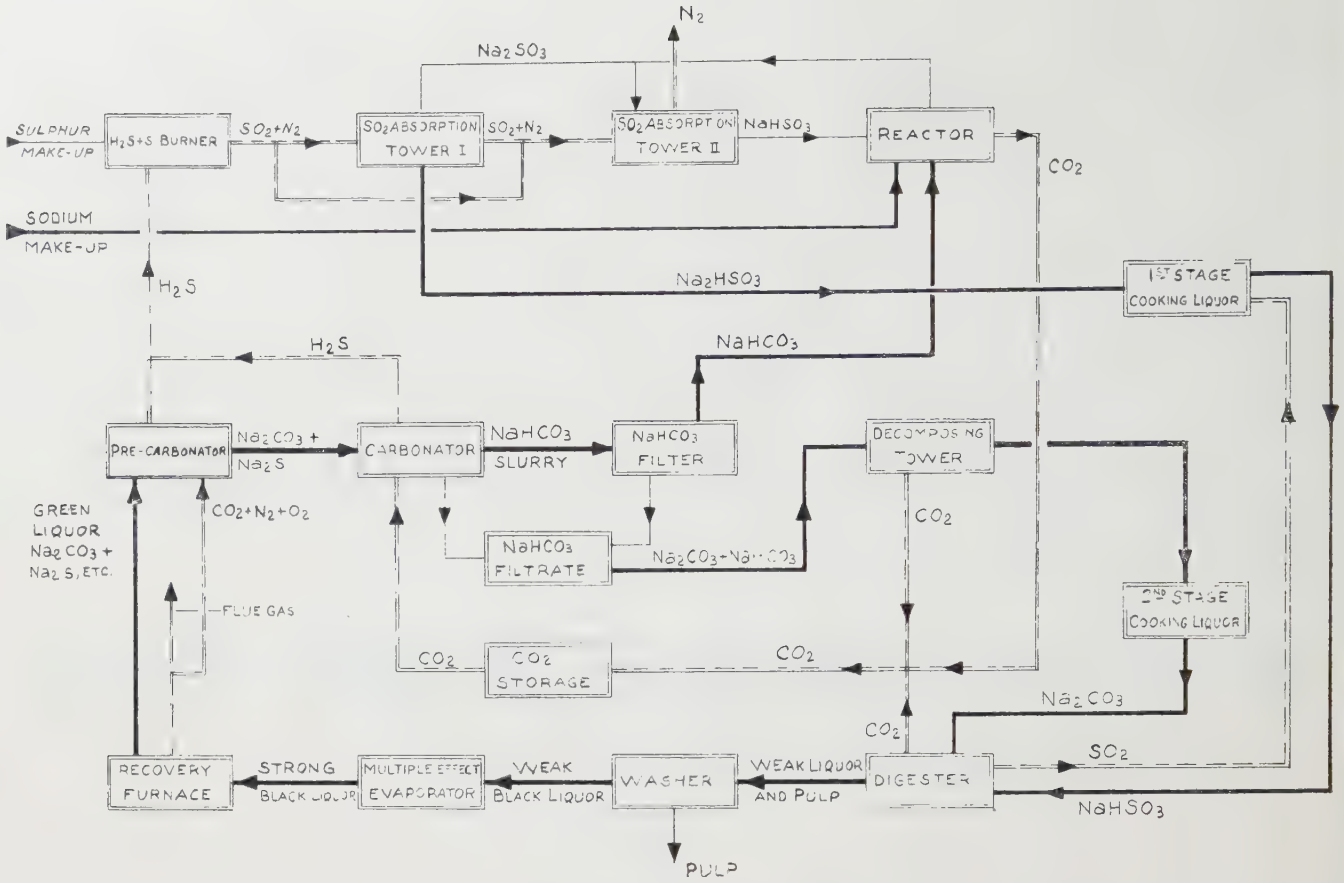

Fig. 1. C-E Sivola recovery process for full chemical, two-stage, $NaHSO_3 + Na_2CO_3$ digestion

A series of cooks using this type of two stage cooking is now being made at the Forest Products Laboratory, and at another paper mill research laboratory on jack pine, oak, birch, and aspen. Similar cooks had been made earlier in Swedish and Finnish paper mill laboratories. A preliminary report on these cooks giving the yields and permanganate number follows (see Table I).

Pulp properties will be available later, and the series may be continued and expanded to determine the optimum conditions of temperature, time, pH, and concentration of the cooking liquors in the two stages.

Since September, 1958, plant-digester cooks were made on the West Coast using the two-stage bisulfite-soda cooking process on western hemlock and red fir. Two cooks were made on each kind of wood and they were kept separate and put through the regular plant bleaching procedure and equipment and over the paper machines. Acceptable bond sheets were made of both

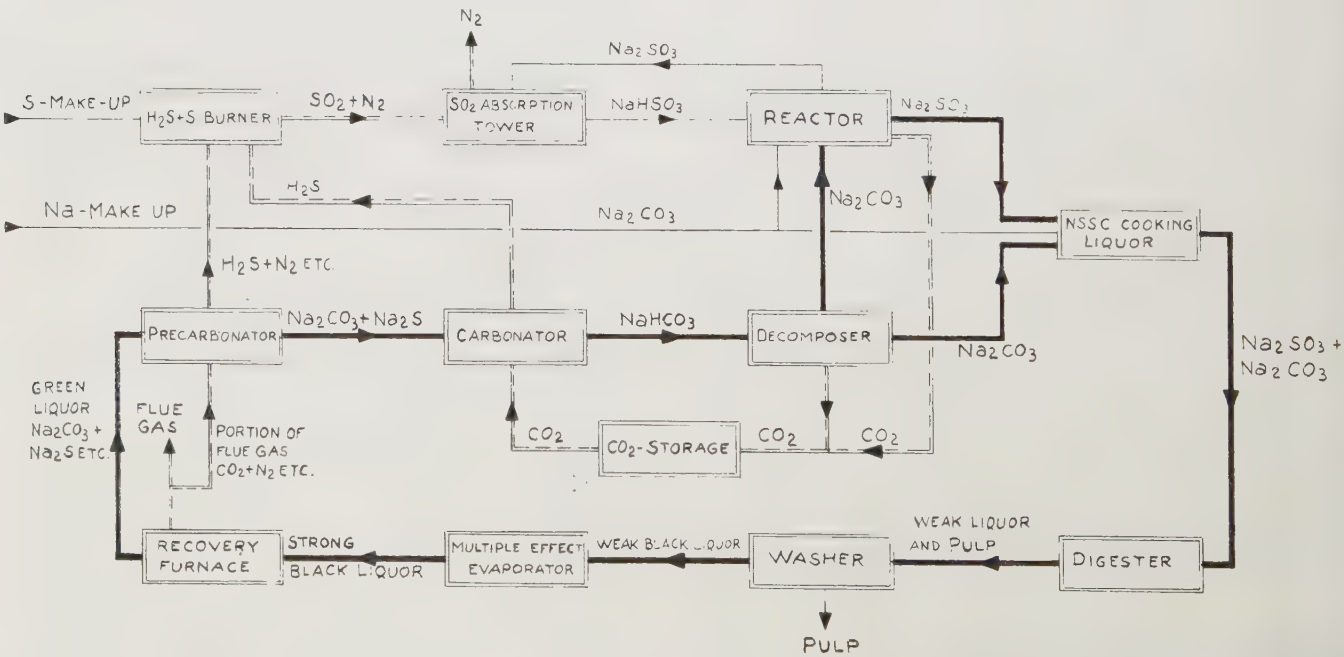

Fig. 2. C-E Sivola recovery system for conversion of chemicals from NSSC digestions

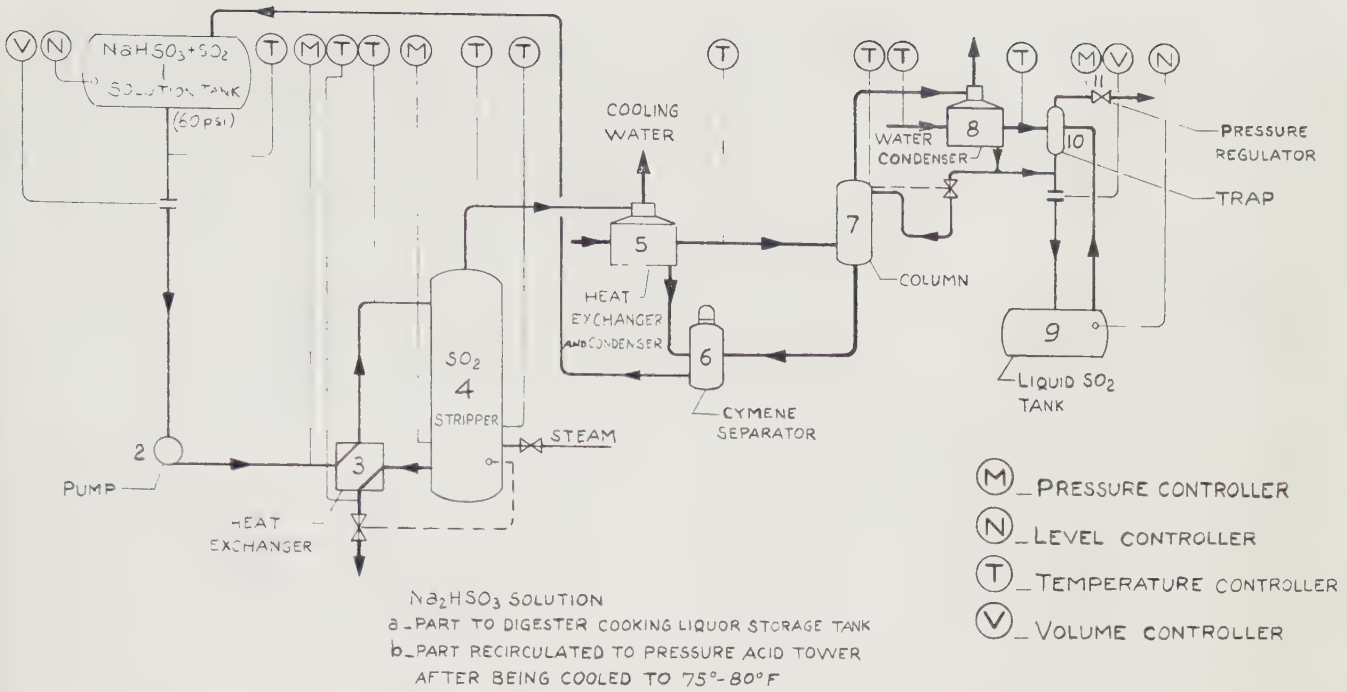

Fig. 3. Equipment for preparation of liquid SO_2

Table II. Unbleached Pulp Properties

Cook no. →	1	1	1	1	1	1	1	2	2	2	2	2	2	2
Permanganate no. →	6.5		6.5		6.5		6.5	8.0		8.0		8.0		8.0
Beating time, min.	*Freeness, S.-R. ml.*	*Approx. C.S. freeness, ml.*	*Burst, %*	*TAPPI burst factor*	*Tear, %*	*TAPPI tear factor*	*Bulk[a]*	*Freeness, S.-R. ml.*	*Approx. C.S. freeness, ml.*	*Burst, %*	*TAPPI burst factor*	*Tear, %*	*TAPPI tear factor*	*Bulk[a]*
						Hemlock Pulp								
0	860	720	25	13	231	164	25.7	860	720	43	22	318	226	26.4
20	780	550	106	53	132	94	15.1	800	585	129	65	148	105	16.1
30	630	340	114	57	119	85	14.0	...	...	...	...	...	...	...
40	450	...	115	58	104	74	13.5	570	280	139	70	131	93	14.4
50	300	...	117	59	102	73	12.8	380	...	145	73	121	86	13.8
Cook no. →	3	3	3	3	3	3	3	4[b]	4	4[b]	4	4[b]	4	4[b]
Permanganate no. →	10.5		10.5		10.5		10.5	17.0		17.0		17.0		17.0
						Red Fir Pulp								
0	870	750	21	11	248	176	28.7	870	750	22	11	222	158	30.6
20	760	515	95	48	160	114	17.2	630	340	100	50	152	108	17.7
30	...	...	...	...	...	...	...	300	...	94	47	142	101	16.7
40	270	...	103	52	137	97	15.7	...	...	...	...	...	...	...

[a] Unfamiliar units.
[b] Because of a shortage of sodium bisulfite for the first stage, about 25% ammonium bisulfite cooking liquor was substituted in cook no. 4.

Table III. Bleached Pulp Properties

Cook no. →	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2
G.E. brightness →	86.5		86.5		86.5		86.5	86.5	85.4		85.4		85.4		85.4	85.4
Dirt count →	3.7		3.7		3.7		3.7	3.7	6.2		6.2		6.2		6.2	6.2
Beating time, min.	*Freeness, S.-R. ml.*	*Approx. C.S. freeness, ml.*	*Burst, %*	*TAPPI burst factor*	*Tear, %*	*TAPPI tear factor*	*Bulk[a]*	*Opacity*	*Freeness, S.-R. ml.*	*Approx. C.S. freeness, ml.*	*Burst, %*	*TAPPI burst factor*	*Tear, %*	*TAPPI tear factor*	*Bulk[a]*	*Opacity*
							Hemlock Pulp									
0	860	720	19	10	231	164	26.4	76.0	860	720	30	15	324	230	24.6	76.0
20	810	610	92	46	156	111	16.1	67.5	810	610	114	57	142	101	16.0	67.8
40	630	340	110	55	123	88	14.6	63.5	570	280	125	63	115	82	14.0	63.0
50	480	200	120	60	111	79	13.8	62.2	450	175	131	66	111	79	13.4	63.0
60	360	...	115	58	109	78	13.5	59.8	320	...	125	63	105	75	13.2	59.8
Cook no. →	3	3	3	3	3	3	3	3	4(1)	4	4[b]	3	4[b]	4	4[b]	4[b]
G.E. brightness →	83.1		83.1		83.1		83.1	83.1	83.5		83.5		83.5		83.5	83.5
Dirt count →	6.2		6.2		6.2		6.2	6.2	3.7		3.7		3.7		3.7	3.7
							Red Fir Pulp									
0	880	775	24	12	269	194	25.2	69.0	880	775	25	13	310	220	26.1	69.0
20	820	630	103	52	155	111	15.9	61.8	740	485	102	51	139	99	16.0	61.7
30	...	...	...	...	...	...	...	...	540	250	110	55	126	90	15.1	60.0
40	580	290	118	59	128	91	14.8	58.7	320	...	111	56	113	80	14.4	58.5
50	420	150	120	60	119	85	14.2	56.0	...	...	...	...	...	...	...	...
60	310	...	113	57	117	83	13.9	53.0	...	...	...	...	...	...	...	...

[a] Unfamiliar units.
[b] Because of a shortage of sodium bisulfite for the first stage, about 25% ammonium bisulfite cooking liquor was substituted in cook no. 4.

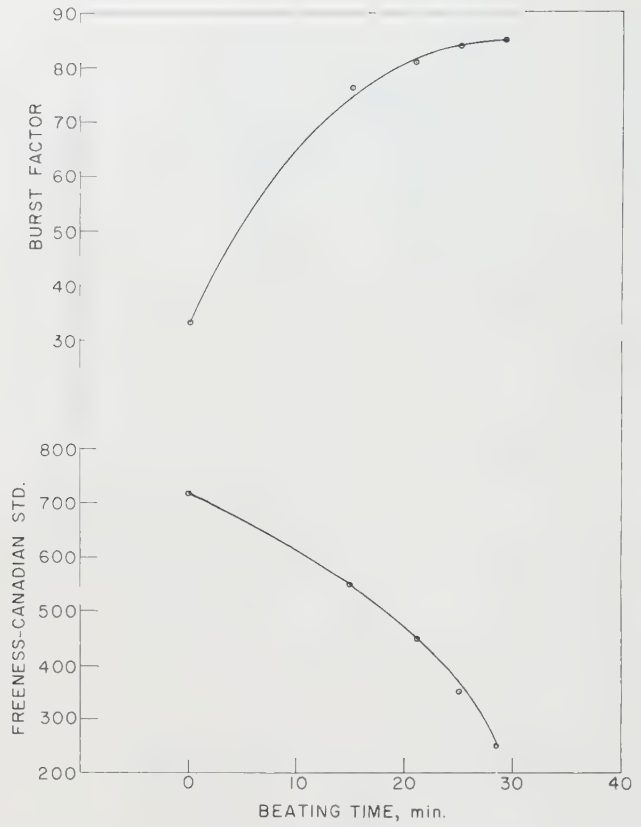

Fig. 4. Properties of unbleached Wisconsin jack pine pulp made by two-stage cooking using $NaHSO_3$ and Na_2CO_3 (cook no. 1649 Y)

Permanganate no., 22.2; screenings on 15 cut plate, 0.2%; pulp passing 15 cut plate, 47.2%; Total pulp yield (based on dry wood), 47.4%.

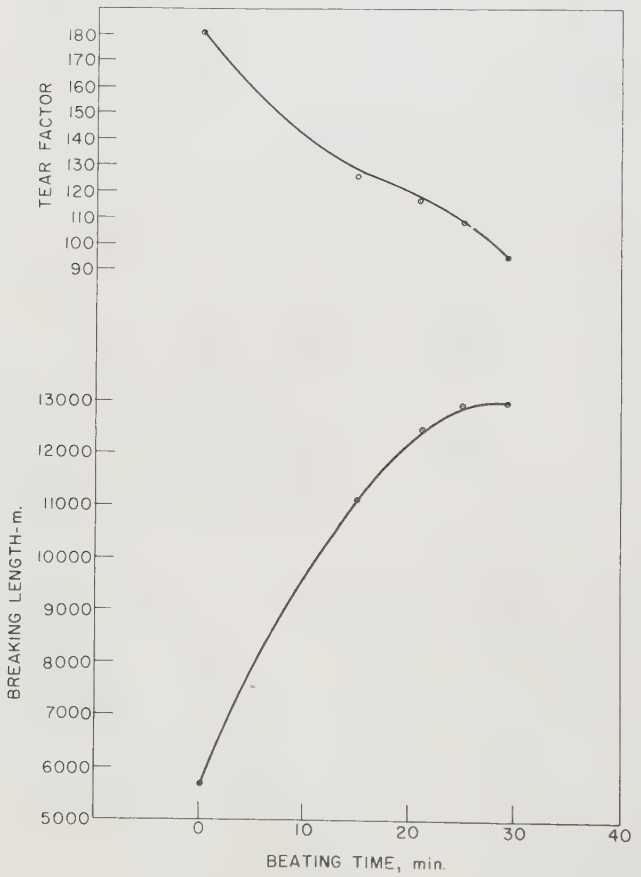

Fig. 5. Properties of unbleached Wisconsin jack pine pulp made by two-stage cooking using $NaHSO_3$ and Na_2CO_3 (cook no. 1649 Y)

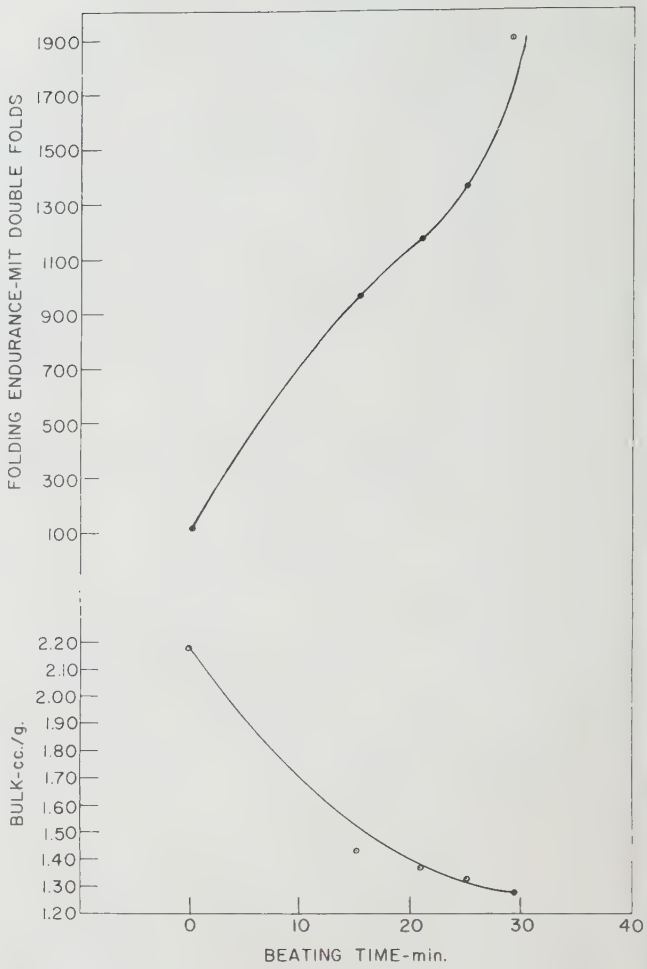

Fig. 6. Properties of unbleached Wisconsin jack pine pulp made by two-stage cooking using $NaHSO_3$ and Na_2CO_3 (cook no. 1649 Y)

12 and 15-lb. grades, but the lighter grade could have been improved with the addition of perhaps 10% short fibered cottonwood pulp. Because of the short run, no information was obtained on pulp yield, but all other pulp and paper qualities were determined and are available.

The unbleached and bleached pulp properties obtained from handsheets after being prepared in the Valley beater are given in Tables II and III. It is expected that further improvement in pulp and paper qualities using these woods could be gained by making additional cooks.

Two plant-digester cooks were also made on North Central poplar mixed with 10% hemlock by the two-stage bisulfite-soda cook. The resulting pulp was used as part of the regular furnish for the mill, passing through the bleach plant and to the paper machines. The results from such a few tests and the small amount of pulp made could not be called conclusive and further cooks were planned.

In regard to old plant expansion and new plant under erection using the Sivola cooking and chemical recovery conversion process, the Rauma-Repola plant in Rauma, Finland, is erecting a new primary recovery furnace and enlarging their conversion equipment to expand their plant capacity of dissolving pulp from 70,000 to 130,000 metric tons per year.

Another company in Finland, Tampella, Oy is erecting a 315 metric ton per day neutral sulfite semichemical pulp and paper mill and has selected the Sivola con-

version process to recover the chemicals from the green liquor. It is significant that this conversion process was selected after the Tampella engineers and their consultant thoroughly investigated other conversion processes available to them.

Interest in two-stage cooking has materially increased during the past year and a half, but much work remains to be done to prove its effectiveness. Therefore, figures given here on yields and pulp properties are not to be taken as the best attainable.

It was mentioned before that a series of laboratory-digester cooks on jack pine and oak were being made at the Forest Products Laboratory, Madison, Wis. We have a preliminary report on one cook on jack pine made by two-stage cooking using $NaHSO_3$ in the first stage and Na_2CO_3 in the second stage. The results are shown in Figs. 4 to 6. It is hoped that a complete joint report will be published later.

Received May 10, 1960. Presented at the 45th Annual Meeting of the Technical Association of the Pulp and Paper Industry, held in New York, N. Y., Feb. 22–25, 1960.

DISCUSSION

Chairman McCarthy: Thank you very much, Mr. Kennedy, for a fine presentation. Are there questions that persons in the audience would like to direct to Mr. Kennedy?

Harry D. Bauman (P. H. Glatfelter Co.): I wonder how difficult, or how important it is in the carbonation stage to convert completely the sulfide to a carbonate, and also, wouldn't it be practical to carbonate at a much higher temperature and go directly to sodium carbonate rather than bicarbonate? In other words, how important is it to get a 100% conversion of sulfide to a carbonate, or don't you worry about that?

Mr. Kennedy: Well, it isn't necessary to get 100%. You don't actually get a 100% because you probably get not more than 95%. Some of the conversion also could take place in the decomposing chamber where CO_2 is still available to react with any unreacted sodium sulfide.

As to why you could not go to sodium carbonate rather than sodum bicarbonate crystals operating at a higher temperature, I don't see why it is not possible to do that. I don't know that it is, but I don't see why not. You would probably get a mixture of $NaHCO_3$ and Na_2CO_3 in solution.

This system was developed intending to get a fairly pure product for the making of the first-stage cooking liquor for high-grade dissolving pulps, where it was felt necessary to obtain a pure chemical for making sodium bisulfide in the first stage.

We had considered that we could leave out the $NaHCO_3$ crystal filtration stage when making semichemical pulp. Here we don't have such rigorous pulp property requirements.

Chairman McCarthy: Any other comments or discussion?

Edward J. Howard (Industrial Cellulose Research, Ltd.): Is there such a thing as a Sivola cooking process? I see in one section of your experiments you used liquid SO_2 in the second stage. And then, elsewhere, you speak of using sodium carbonate for the second stage.

Mr. Kennedy: Well, I did not intend to refer to that as the Sivola cooking process. I did not mean to infer that *that* was the Sivola cooking process. The original Sivola cooking process that was patented and first used consisted of cooking in the first or acid stage with sodium bisulfite, with 2 or 3 or 4% of free SO_2, and the pH might be down as low as three or less in this stage. This was followed by a second alkaline stage with Na_2CO_3 at a pH range of 7 to 10.

If you want to be exact, what you would have to do is to stick to that as a definition of the Sivola cooking process. Mr. Sivola has a Canadian patent for making liquid SO_2, previously mentioned, if this type of two stage cooking is desired.

Chairman McCarthy: I see Dr. Vrjö Hentola of the Pulp and Paper Research Laboratory in Helsinki is here. Perhaps he can tell us something about this.

Dr. Hentola: I don't know anything at all about it. Thank you very much, you are very kind, but I would be wasting your time if I came up here. I can't tell you anything at all about that. Thank you.

Chairman McCarthy: Well, we are very pleased that you are here. Any other questions and comments about this paper? I should like to ask Mr. Kennedy what is the species of wood used conventionally at the Finnish operation?.

Mr. Kennedy: As far as I know, the woods used in Finland would be spruce and hemlock. I imagine that the hardwood there would be birch.

Chairman McCarthy: None of these are highly resinous woods, is that right?

Mr. Kennedy: Yes. The Billeruds Co. in Sweden has made extensive cooking tests on all kinds of woods and several different sulfite cooking processes, and these have been reported and the results of these tests have been reported by Mr. Jörgensen, in a paper given in England, perhaps two years ago, which paper has been distributed to the industry.

There isn't any reason, after you learn how to use the process, that it cannot be used for cooking any type of wood including the resinous pine and fir.

Chairman McCarthy: Any other remarks? Comments? We are creating a relaxed atmosphere, and we do have some time. We can adjourn the meeting very easily but here now are some experts and it isn't often that you have such a distinguished group as these gentlemen available to answer your questions.

May I try a general question? To what extent are the respective processes about which you have spoken amenable to continuous processing as acid and neutral sulfite processes?

Dr. Tomlinson: This looks very encouraging. All we can say is that at present we are installing a unit capable of producing about a ton a day at Cornwall, and we hope to build up some experience.

Chairman McCarthy: Bill, do you have any remarks on continuous operation?

Dr. Gauvin: None!

Chairman McCarthy: Mr. Kennedy, do you have any remarks on this?

Mr. Kennedy: All I can tell you is that the Billerud Co. in Sweden have built and have been operating a continuous cooker pilot digester, but up to date I don't know what the results have been.

There are a number of people here in the audience from Finland and Sweden who might be able to answer that question better than I can and who may have heard a later report. So far as I know, it is just at Billerud Co.

Chairman McCarthy: Is there anyone here from the Billerud Co. who would care to make any remarks about this? Does anyone else have a question to address to this distinguished panel?

Walter G. Meyer (Crown Zellerbach): I have a question to ask of Dr. Gauvin. I presume you injected air into the furnace to make that analysis. Where did you inject it?

Dr. Gauvin: Dr. Meyer, did you refer to the spent liquor? No air was injected at all.

Dr. Meyer: And did you get rid of all your carbon this way?

Dr. Gauvin: Yes, practically.

Chairman McCarthy: May I say to the gentlemen who presented papers, many thanks to you and we hope you will be available this afternoon because the discussions will continue.

To all of you who attended, thank you very much. We will stand adjourned at this time until two o'clock.

The meeting reconvened at two-fifteen o'clock, Chairman McCarthy presiding.

CHAIRMAN MCCARTHY: May I now call for order, gentlemen.

We are continuing the program of this morning relative to recovery systems for sulfite pulp, both acid and neutral type systems. We had three excellent presentations this morning and I believe we have three equally interesting and excellent ones on deck for this afternoon.

The first paper will not have slides associated with it but each of you got a flowsheet and other than slides, the idea is to follow the flowsheet, perhaps.

We will now turn our attention to the first paper titled, "Sodium Base Recovery—Western Precipitation Process," by R. Q. Boyer formerly of the Western Precipitation Division, Joy Manufacturing Co., Los Angeles, Calif.

This is a process of much interest. It has been discussed several times in the last few years. Mr. Boyer.

R. Q. BOYER: Gentlemen, actually, this program was printed some time ago. At that time the name of the company was the Western Precipitation Corp. After last October owing to a transfer of assets, the company name would have read "The Joy Manufacturing Co." and as it is, I have severed my relations with the Joy Manufacturing Co. today and am doing consulting in the general field of recovery systems. I am delivering this paper as an individual.

In order to dispel the implication that I did not feel that this process had merit and that, therefore, I may have left because of that, I would like to state that actually the opposite is true. I would not have left Joy Manufacturing Co. had I not felt this process to be ready to stand on its own feet, and I left my work in the hands of Lauren Berry, whom I wish to introduce to you later because he will have to speak for the Western Preicpitation Division. He is a very, very able process engineer.

Lauren Berry has been with the paper industry for over six years and he will carry on the work although, in effect, the experimentation is over. We built this mill to experiment with. I have heard people say that the mill was not running very well; that it was always getting into trouble. Well, that was very true at the time. You do experiments to find the process limits and when you find them the pilot plant is in trouble, but as a production unit, in my opinion, it is working very well. I am sure Consolidated is very happy that the experiments are over and that the plant is now acting as a production unit.

The Western Precipitation Recovery System

ROBERT Q. BOYER

The Western Precipitation (WP) recovery system utilizing the crystallization separation of the sodium carbonate from the sodium sulfide of the smelt, reacts all of the separated sodium sulfide with the spent liquor sulfite sulfur through an oxidation reduction reaction known as the Bradley process. The reacted liquor is evaporated and burned in inexpensive kraft equipment. Considerable of the sulfur appearing as sulfur dioxide in the furnace gases holds the cyclic system in sulfur balance. The cooking liquor is produced by absorption recovery of the flue gas sulfur dioxide in a sulfite-bisulfite solution that uses the recovered sodium carbonate as the make up base. This system at the Consolidated Water Power and Paper Co. experimental recovery plant has completely processed spent liquor from sodium-base acid sulfite, two stage sulfite and NSSC cooks separately and in combinations. The scale formation in the evaporators is eliminated with the proper pH control by the amount of recycled sulfide sulfur. This sulfur can be either increased with sodium sulfate addition or reduced with inventory sodium sulfide addition respectively to the firing liquor. A pressure-boiling point rise relationship is used to control the evaporation-crystallization. High sulfur, soda and heat recoveries are possible.

THE Western Precipitation (WP) recovery system is designed to handle spent liquors or mixtures of spent liquors, from many present or future type of acid, neutral or alkaline sulfite pulping processes. Within reason kraft or soda liquor can be recovered simultaneously in the same equipment which is basically standard kraft and soda recovery machinery (*1*). The addition of kraft or soda requires the obvious addition of a causticizing step.

The advantage of such a flexible system is that the pulping knowledge is not complete and the pulping requirements change with changes in papermaking requirements. It is highly desirable for a pulp mill, at least at present and probably always, to remain uncommitted with large capital expenditures. Efficient future planning dictates that an action on such a large capital expenditure with a 25-year life should not be committed unless such machinery is adaptable to technological advancement; in the case of a pulp mill to the changes of pulping needs.

It appears to be obvious, to the writer, that the rapid advancement of the kraft process over the sulfite process has probably been due to the fact that the sulfite industry, by the nature of their machinery and techniques, was committed to a single type pulping method based upon the economy of wasting the spent chemicals to the stream or simple disposal methods. On the other hand, the chemical engineer, having developed for the kraft industry a flexible though expensive bleaching system justified and permitted the planning and expenditure of capital on the uncommitted kraft pulping, bleaching, and recovery equipment.

That this process under discussion can accommodate any type liquor or that the equipment can be converted to operate the kraft or soda recovery is one of its outstanding advantages. That a recovery system exists which raises the former limitations of the amount of chemical used by the sulfite process or the method of applying it, gives a possibility of the sulfite industry revivification and its possible dominance over the kraft method. This is particularly true since recent pulping work shows that with soluble base and heavier amounts of chemical on the wood the sulfite methods will handle an equally broad range of woods as that handled by the kraft process.

ROBERT Q. BOYER, formerly Head of the Chemical Process Dept., Western Precipitation Division, Joy Manufacturing Co. At present an independent consultant on general recovery problems. P.O. Box 662, Madison, Wisconsin.

HISTORY OF THE DEVELOPMENT

The WP system was conceived nine years ago. It was the outgrowth of a year of economic evaluation of all possible variations of the soda base recovery technique. We were able to draw on the knowledge and experience of the late Lynn Bradley who was at that time the foremost living worker in the field of soda-base pulping and recovery (*2*). With this aid we were able to incorporate in the study all of the unit operations which are presently being advocated for soda-base recovery. The exceptions were, of course, the Bradley reaction, which was an outgrowth of the study, and the work of Professor Gauvin, which seems to be one of the few other novel developments in this art.

The results of the analysis indicated that for the basic problem there were a multitude of methods available for the conversion of the sulfide in the green liquor to the required sulfur dioxide. The simplest of these was the return of the sodium sulfide from the green liquor to the furnace. The furnace itself would then be the unit operation for the entire production of the recovered sulfur dioxide (*3*). This appeared highly desirable as considerable of the sulfur dioxide would be produced in the furnace under any conditions.

Under most conditions the spent liquor concentration from the sulfite process is lower than in the kraft process. For this reason the size and number of evaporators should be greater than the kraft process. This would dictate mild steel construction of the evaporator system. Mild steel construction requires not only an alkaline liquor, but one which is noncorrosive and whose vapors are noncorrosive in the subsequent vapor belt of the multiple effect sequence. Work and knowledge before 1900 indicated that sulfite ion is detrimental in mild steel evaporators. There was only one logical conclusion; the alkalinity of the sodium sulfide would have to be used as the neutralizing agent, but to use this agent would require that the sulfide and the sulfite ion be destroyed (*4*). This had never been done.

The research was then directed toward oxidation reduction reactions which would combine the potential sulfite ion with the sulfide ion present in the spent liquor sodium sulfide mixture. The result is the Bradley-Boyer reaction and the Bradley process which, briefly, is the addition of sodium sulfide to the spent liquor, the removal of calcium and dregs and the oxidation reduction combination of the sulfide and sulfite.

While the unit operation had been created, sufficient data had to be compiled to permit a detailed engineering estimate of an entire system. The high sulfidity end of the phase diagram of the system sodium sulfide-sodium carbonate-water was developed (*6*). A semiworks Bradley process, continuous evaporator and furnace were set up for continuous operation. The sodium-base spent liquor was produced by ion exchange of calcium-base liquor. The best results were checked against sodium-base spent liquor produced for the experiments by the Central Research Department of Crown Zellerbach Corp., who also supplied the calcium-base spent liquor. Simultaneous experiments with finely ground kraft smelt and with smelt produced in the semiworks furnace showed the possibility of producing a pure sodium carbonate crystal by isothermal recrystallization of a highly comminuted smelt (*6*). The semiworks laboratory evaporator was also devised as a corrosion test machine in that the single mild steel tube heat exchanger could be removed and weighed on an analytical balance as could a mild steel condenser which was operated in conjunction with the equipment.

On the basis of the above work a recovery system was synthesized. In joint effort with J. M. Hull of the Crown Zellerbach Corp. a 200-ton plant engineering study was undertaken. The results of this detailed study gave an accurate picture of the machinery sizes and flows and a fairly accurate estimate on the capital investment required. This work was particularly helpful as the Western Precipitation Corp. did not have an overall experience with the modern practices of a paper mill recovery department.

The only part of the experiments in which there was considerable doubt was the furnace operation. In spite of the fact that considerable care had been exerted to duplicate the conditions of a large scale furnace, erratic results were obtained; also, we were warned by others who had attempted sodium-base spent liquor burning that the results of any small furnace could not be relied upon to be duplicated in a large furnace (*7*). Of course, the critical part of the process was to establish how the sulfur would partition between the smelt and the furnace gases in a commercial size furnace. The Nekoosa Edwards Paper Co. undertook to run sufficient full scale tests to establish the burning factor of the process. In addition, they undertook to establish the feasibility of producing pure isothermal recrystallized sodium carbonate by comminution of the smelt with the technique of blowing it with steam in a manner similar to which slag wool is produced.

The mill-scale tests were conducted by Professor C. P. Donofrio, then on sabbatical leave from the State College of Forestry at Syracuse, and R. A. Nugent of Nekoosa Edwards Paper Co., in cooperation with the Swenson Evaporator Co. who assumed responsibility for the evaporator problem. Considerable economic evaluation was undertaken simultaneously. The results of this year of work were reported in two papers (*8*, *9*). The conclusions were that the process was technically feasible and economically attractive even for the conversion of calcium-base mills of at least 150 tons daily production.

During the course of the tests Consolidated Water Power and Paper Co. became interested in the work, and they were kept informed of the results. They undertook to continue the work beyond the original tests. After an economic study based on the Nekoosa results they retained the Western Precipitation Corp. as consultants. With the completion of planning, the Western Precipitation Corp. was retained as consultants for the building and operation of the experimental plant. Results of the first year of operation were reported at the 44th Annual Meeting of TAPPI (*10*). Acknowledgments of the participants were made at that time. This present paper will summarize the system as established by us as a result of the past year of operation wherein the variations in the process condition have established the parameters of the process and the operating equipment.

DESCRIPTION OF THE PROCESS

Figure 1 shows the components of, say, a 200-ton

recovery plant. The spent liquor and the sodium sulfide mother liquor are combined in a pump. The sodium sulfide liquor is drawn from an inventory of mother liquor produced in the crystallization of pure sodium carbonate. This is done by evaporation-crystallization of the dissolved smelt which was produced by the burning of the treated mixture. pH control is used to regulate the amount of sodium sulfide added from inventory.

The mixed liquor flows to a Dorr-type settler or thickener which is sized to give at least 2-hr. retention. The calcium carbonate formed in the mixture, furnace dregs which accompany the sodium sulfide and the pulp remaining in the spent liquor are mostly removed in the thickener. The overflow is pumped through pressure filters to remove the traces of pulp, calcium, and dregs not taken out in the settler. This liquor then flows to the Bradley process oxidation step where the entire liquor is converted to a foam. The method of doing this is to expose the liquor to carbon diffuser plates which are blowing 10 cu. ft. of air per gal. of liquor treated. The foam overflows into a foam breaking tank in which the foam is permitted to break. The retention time of the liquor as foam is between 15 to 30 min. During the treatment period the sulfide and sulfite ions with the aid of oxygen combine to form polythionates and thiosulfates.

The treated liquor discharged of its air is stored for use in the multiple effect vacuum evaporators. The multiple effect evaporators are the standard kraft type in mild steel. As is done with the kraft evaporators, the first and last effects have stainless steel tubes. The liquor is evaporated from, say, 13% solids to 45 to 50% solids. It is discharged into surge storage before final concentration for burning.

The concentrator is the first effect of a multiple effect system. The concentrator vapor operates in series the two evaporator-crystallizers that are under vacuum. The liquor is evaporated in the concentrator to from 65 to 70% solids. This is fired directly in the furnace. A part of the stored liquor is sent to the salt cake mixing tank to dissolve the sodium sulfate from the electrical precipitator and any sodium sulfate used as makeup. This stream with the sodium sulfate meets the stream of liquor going to the furnace. The liquor is heated to 240°F. by steam injection and then sent to the furnace sprays.

The furnace is a standard kraft furnace. The burning is carried on in two distinct phases. The liquor is dried and charred either in suspension or on the walls. This releases considerable of the combustibles and all of the sulfur that is released. The combustion air from a gas to air heater can vary from 350 to 700°F. depending upon need for the type of liquor burned. The secondary air completes the combustion of the released gases. The char consisting essentially of carbon, sodium carbonate, and sodium sulfate, falls to the bottom of the furnace into an ash heap. The primary air maintains combustion of this char under reducing conditions where, in the ash heap, the sodium sulfate is reduced to sodium sulfide. The melt of sodium sulfide and sodium carbonate flows from the furnace. This smelt is approximately an equimolar mixture of sodium sulfide and sodium carbonate.

The combustion gases discharge their heat into the boiler, economizer and the shot cleaned air heater, leaving the recovery unit at approximately 300°F. The gases contain some sodium as sodium sulfate fume and have from 0.7 to 1.5% sulfur dioxide by volume. The fume is removed in an electrical precipitator which returns sodium compounds to the furnace. The sulfur dioxide is recovered in a countercurrent absorption tower. The scrubbing solution is a mixture of sodium sulfite bisulfite which is converted by the time it reaches the bottom of the tower to a sulfite-bisulfite solution that is 90% bisulfite.

The smelt flows from the bottom of the furnace at 1550°F. This stream is shattered and dissolved to an approximately saturated solution known from the kraft industry as green liquor. A density control is used to limit the amount of water added at this point. The saturated solution of green liquor is pumped to storage which is a surge for the crystallizer system. The outlet flow is on green liquor need as required by the steam supplied to the concentrator-crystallizer multiple effect system.

The green liquor is pumped to the low vacuum effect of the crystallizers. This flow is governed by a set ratio of liquor to vapor available for evaporation. This ratio is re-set by the liquor temperature in the high vacuum effect which is operated at a constant vacuum of 26 in. Hg. The instrumentation controls the composition of the mother liquor. The slurry from the first crystallizer discharges into the second crystallizer which discharges into a settler. Here most of the dregs overflow with the sodium sulfide rich mother liquor that is stored in an inventory tank to wait mixing with spent liquor.

The slurry solids consist mainly of pure sodium carbonate monohydrate crystals of from 20- to 60-mesh size. There is also some of the heavy furnace dregs. The 130°F. slurry is filtered on a vacuum filter having two stages of wash. The filter cake which has a better than 95% purity, can be dissolved and the solution used directly for recovery of sulfur dioxide in the preparation of the cooking liquor, or if desired, it can be resuspended and screened on a washing screen to produce +99% purity sodium carbonate crystals.

The sodium carbonate solution is pumped to the sulfur dioxide recovery tower head tank where it is mixed with part of the sulfite-bisulfite liquor from the bottom of the recovery tower. The carbon dioxide and any traces of hydrogen sulfide formed during the neutralization are discharged to the stack or preferably into the combustion air. The unit operation forms a sulfite-bisulfite solution rich in sulfite. This solution flows countercurrently down the sulfur dioxide recovery tower. The vapor pressure over the solution is such that, with the four theoretical transfer units of the tower, only 300 p.p.m. sulfur dioxide remain in the stack gases. This is considerably less than would be found in burning low sulfur oil or coal.

The tower solution is divided so as to hold a constant level in the head tank. The rest is sent to the preparation of the cooking liquor and contains the total recovered sulfur. If a neutral of alkaline cooking liquor is desired the recovered sodium carbonate stream is split and part is mixed with the recovery tower liquor. If this is an acid process, the tower liquor

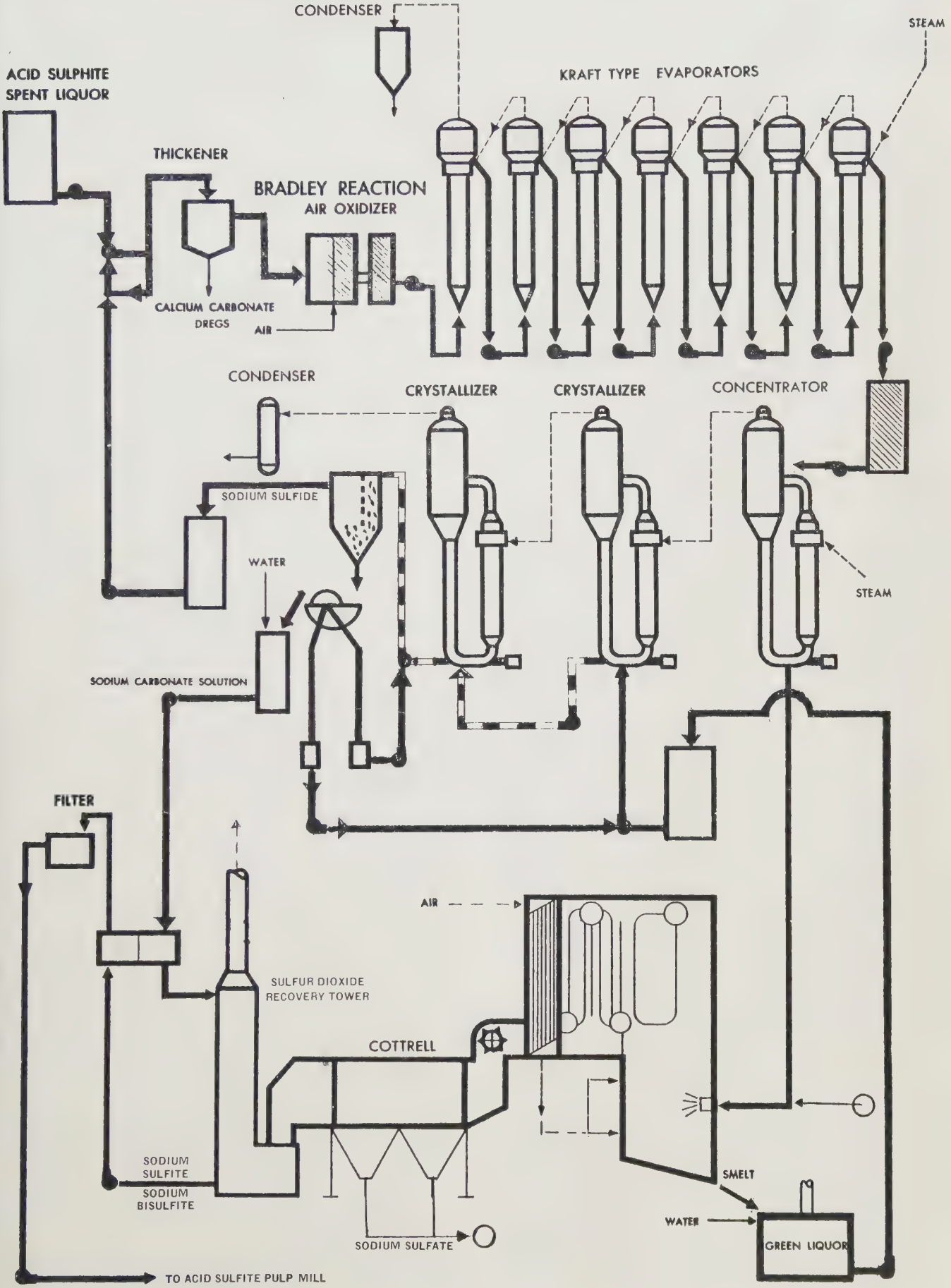
CONDENSER
STEAM
ACID SULPHITE
SPENT LIQUOR
KRAFT TYPE EVAPORATORS
THICKENER
BRADLEY REACTION
AIR OXIDIZER
CALCIUM CARBONATE
DREGS
AIR
CONDENSER
CRYSTALLIZER
CRYSTALLIZER
CONCENTRATOR
SODIUM SULFIDE
WATER
STEAM
SODIUM CARBONATE SOLUTION
FILTER
AIR
SULFUR DIOXIDE
RECOVERY TOWER
COTTRELL
SODIUM
SULFITE
SODIUM
BISULFITE
SODIUM SULFATE
SMELT
WATER
GREEN LIQUOR
TO ACID SULFITE PULP MILL

Fig. 1

contains all of the recovered sodium, and the solution is fortified with the required sulfur dioxide makeup after it has been cooled and diluted. Filtration through a precoat filter easily removes the small amount of particulate left in the solution.

THE BRADLEY PROCESS

We do not wish to labor the details of the chemical reactions involved. These discussions have appeared in a considerable number of other papers. Suffice it to say that with or without the addition of oxygen the sulfide ion added to the spent liquor is cause to react particularly with the sulfite and lignosulfonate so as to effectively destroy the sulfite ion. The result is that little or no volatile sulfur compounds are given off during evaporation. Were this reaction not performed, experiments have shown that 60% of the added sulfide ion would volatilize as hydrogen sulfide or sulfur dioxide. This volatilization problem, known before 1920 (*11*), prevented the obvious solution of the recovery problem by the addition back to the spent liquor of part of the green liquor in order to use mild steel evaporators.

We hold no particular brief with the present machinery that we are using for performing the chemical reaction or for the pretreatment of the liquor after mixing. Probably any method which will form the mixture into a foam then permit this foam to collapse would be satisfactory for the operation. Any absorption method that would present an extended surface should be acceptable. Previously we used the pressure reaction for the oxidation reduction. Although this reaction appears to be more quantitative, it involves considerably more expensive equipment, and the black liquor contains mercaptans which have the offensive odor of kraft black liquor.

Any device that will hold the liquor for sufficient time for the calcium carbonate to precipitate and then removes the calcium carbonate, other precipitated sulfides and carbonates, dregs and pulp would be a satisfactory treatment after mixing the liquor and before the Bradley reaction. One of the reasons for the removal of the particulate material stems from our present method of diffusing the air. The carbon plates plug so that after a week's time they must be flushed with condensing steam and sulfur dioxide and after two months' operation must be brushed. A flexible fabric diffuser such as is used in some sewage treatment plants has been shown to give a satisfactory foam. The manufacturers claim that this type of diffuser can be flexed to remove the incrustations. The pressure drop for equal flow rates and areas appears to be larger than for carbon blocks.

BLACK LIQUOR EVAPORATION

Of major importance in the past year has been the completion of studies of the relationship of evaporator scaling to the process. The influences are parallel to those on kraft liquors. It is surprising but true that the treated neutral sulfite liquor tends to scale at a higher pH than does the treated acid sulfite liquor. However, if sufficient inventory sodium sulfide is added back to keep the process in material balance there is no detectable scaling rate with any of the liquors studied. As a matter of fact, if scaling has been formed by evaporating a low pH liquor which had been inadvertently produced, the liquor at the proper pH for material balance will actually remove this scale. It has been established that these scale formations are organic materials, but their composition has not been determined.

There are other types of scale which have been noted during deliberate experimentation. Pulp fiber is the most serious. This is similar to the experience of the early days of the kraft industry when diffuser washing was common practice. The pulp must be strictly eliminated from the treated liquor going to the evaporators. The particulate calcium carbonate must also be removed as, surprisingly enough, it will in time build a calcium scale. All these scale-forming tendencies are removed from the liquor in the Bradley process; and thus the heat transfer coefficients remain at the rate ordinarily found in a kraft evaporator.

From the condition of the tubes in the evaporators it is obvious that the liquor on the liquor side has a similar or smaller corrosion rate than that of kraft liquor. Vapor-side corrosion has not been studied since the original Nekoosa work. This work indicated approximately 9 mils per year vapor-side corrosion rate. An advantage over kraft is that the scale-forming hydrogen sulfide present on the vapor side in large amounts in the kraft system is absent.

Our work with the concentration of these liquors to between 65 and 70% solids we feel is a major contribution to the art of recovery. We are still using the original machine that was built by the Nekoosa Edwards Paper Co. for their tests. The design was created by Harvey Waters of the Swenson Evaporator Co. It has been eminently satisfactory. The heater is fully submerged. In the evaporator-art parlance this means that throughout the heater there is sufficient back pressure to prevent localized boiling. High velocities suppress the formation of scale even under conditions where organic and inorganic precipitation are taking place in the machine.

The tubes are type 304 stainless steel. There has been no detectable wear or corrosion. In spite of all types of deliberate and inadvertent conditions within the machine only one instance of tube pluggage has been observed. This has been so, even though through experimentation, conditions have been created which plugged the flashing head and downcomer. Feed to steam ratio accurately control the concentration. Evaporator level controls the feed. A boiling-point rise device indicates the concentration. The present concentrator operated on 35 lb. steam, discharges its vapor at atmospheric pressure. The vapors will feed into the steam chest of a two effect evaporator-crystallizer giving triple effect economy to the steam utilization.

The use of this concentrator eliminates the need for a direct contact evaporator. As far as furnace operation is concerned there are the following advantages beyond the saving of heat:

1. The liquor being fed directly into the furnace is hotter, requiring less direct steam to heat to the proper spraying temperature.
2. The liquor is smooth and has no baked particles; this eliminates control valve and furnace spray nozzle plugging.
3. Accurate concentration is maintained; this is independent of wide swings in the furnace combustion.

4. The elimination of the direct contact evaporator eliminates this largest single source of odor from a recovery department.

The viscosity of the thick liquor at 65% in the concentrator has been determined as 100 cp. at 230°F. This is similar to kraft liquor and there should be no reason that the kraft industry could not take advantage of the present development for heat savings and the elimination of their only uncontrollable source of air pollution.

EVAPORATION CRYSTALLIZATION

Characteristic of the WP recovery system is the separation of the crystalline sodium carbonate as the base for the production of cooking liquor. Simultaneously there is the production of sodium sulfide rich mother liquor to be mixed with the spent liquor. The mixture is subsequently reacted by the Bradley process.

The original work on the separation consisted of first deriving the phase diagram of the system sodium carbonate-sodium sulfide-water (*6*). This was produced during 1951 and was widely distributed to the paper industry. However, other workers had previously recognized the selective solubility of sodium sulfide in the presence of sodium carbonate. Following laboratory tests large scale experimentation was conducted with finely divided smelt produced by blowing (*9*). In addition, prior to the construction of the evaporator-crystallizer at Consolidated, pilot work was done with the operation of the evaporator-crystallizer at the Sulfite Manufacturers Research League station. Both commercial scale tests confirmed the phase diagram. There was, however, always the question of whether at atmospheric pressure evaporation, sodium carbonate crystal would appear as an anhydrous salt or as a monohydrate.

It is an unfortunate circumstance of phase relationship that the transition point between the monohydrate and the anhydrous form of sodium carbonate is almost exactly at the temperature produced by the boiling point rise at atmospheric pressure. As one follows down the phase diagram to high sulfidities, the additional ionic concentration raises the boiling point to where, at atmospheric pressure, the anhydrous salt is produced. Were the system set up so that settling and filtration could be done under pressure no harm would ensue. The settling could be done with a smaller vessel and the filtration accomplished with ease. Indeed a patented process exists for the production of the anhydrous sodium carbonate under mild super atmospheric pressure. It was not until this process was noted that the difficulties which we were encountering with the evaporator-crystallizer were solved.

The facts were, that the anhydrous sodium carbonate powder was being produced within the body of the evaporator at equilibrium conditions; that the slurry pumped from the evaporator to the settler and subsequently to the filter was under such temperature conditions that the anhydrous powder would recrystallize as a monohydrate. The operating conditions were aggravated by the fact that this recrystallization continued throughout the settler and filtration system so that plugging of lines, agglomeration of large masses of crystals and extremely fine crystals going to the vacuum filter, were the rule rather than the exception.

No actual phase diagrams had been constructed for the transition point so an indirect physico-chemical solution was resorted to the problem. The solution is interesting enough to present here. Indeed it was just a year ago, at this TAPPI meeting, that an interchange of information gave us this lead. While the International Critical Tables had not given the transition point of the sodium carbonate as a function of temperature thep fortunately gave the vapor pressure of the sodium carbonate monohydrate as a function of temperature.

With direct reasoning or, more elegantly, by applying the phase rule one can prove that if the vapor pressure of the solution at any temperature is greater than the vapor pressure of the monohydrate then the salt will exist entirely as a monohydrate; however, if the vapor pressure of the monohydrate salt is greater than the vapor pressure of the solution in contact with it the salt will exist entirely as the anhydride without regard to the composition of the mother liquor. One can compute the vapor pressure of solutions at any temperature which, for a given composition, has a certain boiling point rise when boiling at atmospheric pressure.

It was known from the atmospheric operation of the evaporator that the boiling point rise was as much as 20°C. These curves were computed assuming Raoult's law which, suitably rearranged, predicts that if the vapor pressure of a solution is known at one temperature and if the vapor pressure of the pure solvent is known throughout the range of temperatures, the vapor pressure of the solution at any temperature will be the same fraction of the vapor pressure of the pure solvent throughout the range of temperatures.

Figure 2 shows the relationship of these two factors. The solution vapor pressure curves can be considered curves of constant composition. The sodium carbonate vapor-pressure curve may be considered a limiting curve; thus all operating points to the left of the curve will produce the monohydrate within the evaporator-crystallizer and subsequent removal will not change the form of the crystal. It can be seen that the minimum vacuum that can be applied to the crystallizer producing a mother liquor having the 20°C. boiling-point rise at atmospheric pressure will be approximately 26-in. vacuum.

These curves have simplified enormously the evaporator-crystallizer operation. Once a chemical analysis has established the mother liquor sulfidity, the evaporator-crystallizer may be held on an indicated constant-composition curve and within the bounds of the monohydrate crystal vapor-pressure curve. This produces a constant composition of mother liquor with a considerable degree of accuracy.

The present instrumentation of the evaporators automatically ratios the steam flow to the liquor flow. A hand re-set of this ratio holds the evaporator-crystallizer conditions on a constant-composition curve. Future instrumentation is indicated by holding the vacuum constant and automatically re-setting the steam to liquor ratio so as to hold a constant temperature of the liquor in the evaporator-crystallizer body. The entire operation then can be controlled without attention.

The filtration which is conducted now at approx-

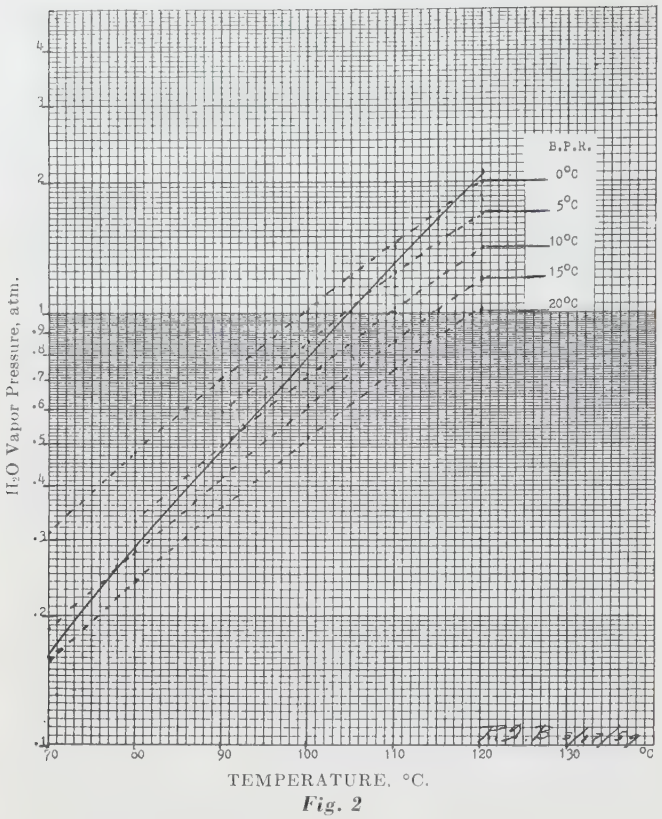

Fig. 2

——$Na_2CO_3 \cdot H_2O \rightarrow Na_2CO_3(s) + H_1O(g)$. – – – – – Raoult's Law vapor pressure lowering at various boiling point rises.

imately 140°F. is carried out on a rotary vacuum filter. The light dregs overflow the settler. The heavy dregs are filtered out on the crystal mat. With a single wash 95% purity crystals can be obtained. For most purposes this is satisfactory. However, if desired, the crystals may be resuspended in a saturated sodium carbonate solution and drained on a strainer type screen to produce +99% purity crystals. The wash from the drainer screen may be sent to the crystallizer after settling the heavy dregs which have been removed from the drainer.

FUEL VALUE OF BLACK LIQUOR SOLIDS

One item which we should examine thoroughly in regard to its influence on heat recovery is the effect of the addition of the sulfide recycle to the spent liquor. The intuitive feeling is that this is a considerable heat drain over that of simply burning the evaporated spent liquor without treatment. As we shall see, the magnitude of this effect is not great. The actual heat drain can be set forth as several factors.

1. The increase in sensible heat of the smelt due to a two to threefold increase in the amount of smelt.
2. The increase in the latent heat of fusion due to an increase of smelt.
3. Any increase or decrease in the heat of reaction of the reduction of the sodium sulfur compounds to sodium sulfide.
4. The loss of fuel value by the consumption of carbon in the reduction.
5. The correlation of the corrections of the bomb values due to the bomb formation of the sulfate and the mass correction for inert material.
6. The effect of oxygen added to the organic compounds of the fuel by comparing it to combustion air it replaces.

Items 1 and 2 are real and the magnitude will be shown by calculation.

Items 3 and 4 appear as one mechanism and the surprising results can be explained on the basis that all of the heat of the production of recovered sulfur dioxide is given up in the furnace in comparison with the alternate mechanism. It should be remembered that while the bomb tests show considerable heat of reduction, in order to correct the bomb results, in fact, the added sodium sulfide appears in the fuel as sulfur in the zero oxidation state which has only to be reduced to the −2 oxidation state in order to form all the sodium sulfide. Whereas, in contrast, one half of the sulfur which enters in the alternate method as bisulfite must be reduced from the tetravalent state to the −2 oxidation state in the furnace. The formation of sulfur dioxide and sodium carbonate from the bisulfite is exothermic, but we must take into account the loss of carbon as fuel.

As for item 5, this analysis disagrees with that given in the book "Pulp and Paper Manufacture" in the application of the correction applied to the bomb value to give the true heat yield to the furnace. While there is no difference with kraft liquor, a more exact method is considered necessary with sodium-base sulfite liquors. The basic principal adhered to is that the fuel value is corrected from the chemical products of the bomb to the chemical products in the furnace. By the chemical nature of the bomb tests all of the sulfur is converted to sodium sulfate. The carbon may be converted to sodium carbonate and carbon dioxide or additional carbon dioxide may be formed from sodium carbonate added in the bomb test. In kraft liquors exactly as much carbonate is formed in the bomb as in the furnace so this factor has been ignored. The true corrections, therefore, are computed in the following manner:*

1. Determine the amount of sodium that will appear in the furnace as sodium sulfide.
2. Subtract the moles of total sulfur from the moles of sodium sulfide. This will give the amount of sodium sulfate formed in the bomb which will appear in the furnace as sulfur dioxide; also it is the number of moles of carbon dioxide excess and lack of sodium carbonate in the bomb had it formed the proper products by combustion.
3. Subtract from the bomb value the heat value of the weight of sodium sulfide from 1 in the reaction:

$$Na_2S + O_2 \rightarrow Na_2SO_4$$

4. Subtract from the bomb value the heat value of the weight of sulfur dioxide and sodium carbonate from (2) in the reaction:

$$Na_2CO_3 + SO_2 + {}^1/_2O_2 \rightarrow Na_2SO_4 + CO_2$$

As we have stated before, the bomb value of the fuel *per se* has little to do with the efficiency of the fuel or the yield of heat per ton of pulp production. It is also to be remembered that one must consider the fact that there are more pounds of fuel being sent to the furnace when inorganic materials and oxygen have been added to the fuel. For this reason a realistic comparison would be to consider the number of B.t.u.'s. produced

* If water rather than sodium carbonate solution is placed in the bottom of the bomb before firing, subtract from the total moles of sulfur twice the moles of total sodium. If the result is negative, ignore the following. A positive result will give the amount of sulfuric acid formed in the bomb which will appear as sulfur dioxide and water in the furnace. Subtract this from the result in (2) to give the proper value for (2), use this value in (4). Also subtract from the bomb value the heat value of the weight of sulfur dioxide and water from the above in the reaction:

$$SO_2 + H_2O + {}^1/_2O_2 \rightarrow H_2SO_4$$

as steam per pound of carbon present in the fuel rather than the number of B.t.u.'s. produced as steam per pound of fuel.

In considering item 6, the added oxygen is available for the formation of carbon dioxide without the need for heating up four molecules of nitrogen for each molecule of oxygen required to produce the carbon dioxide. This also has a pronounced effect on the flame temperature wherein each accompanying molecule of nitrogen must be heated to 2500°F. The parallel case might be explained simply as that of TNT as compared to toluene. The TNT has a lower bomb value, but a higher flame temperature and heat yield when burned with air as compared with toluene.

Calculations might be done with model compounds. However, we have approached the consideration in another manner; for we know the approximate amount of heat given up in the Bradley reaction and, therefore, can assume that the true fuel value has been reduced by this amount by the addition of oxygen to the fuel. This can then be compared with the saving of heat due to the smaller amount of oxygen required in the combustion air, and the heat saved in heating up the four nitrogen molecules for each oxygen in the combustion air. It is for this reason that we believe that in both the Bradley process and the Bergstrom Trobeck process the oxygen added is not reflected in lowered heat production although it does indeed lower the apparent fuel value of the black liquor solids.

The conclusions of this section are that there is not a significant change in the production of steam by the use of the Bradley process black liquor over the most idealized method of burning the liquor as the acid sulfite.

OVERALL STEAM ECONOMY

One of the most obvious points about this process is that there is more water to be evaporated than, say, a process in which the spent liquor is taken in to the evaporators from the blow pits or washers, and without treatment directly evaporated to firing concentration and burned. This increase in evaporation is equivalent very nearly to the amount of water which is added at the dissolver to dissolve the smelt. It will now be shown that if one obeys the ordinary economic rules of chemical engineering the steam consumption will be no greater than that required by the alternate method and the net steam production is considerably better than a combination which would employ a direct contact evaporator.

System I utilizes three stainless steel LTV evaporators and two FC evaporators. The liquor is concentrated to 57% for firing. An air heater acts as a heat trap and an electrical precipitator is used for dust collection. System II utilizes a direct contact evaporator for final concentration. Two stainless steel LTV's and two stainless steel FC's are used to concentrate the liquor to 40%. System III utilizes seven mild steel LTV's to concentrate the liquor to 45% and one stainless steel FC to concentrate the liquor from 45 to 65% solids with triple-effect economy. The vapors from this concentrator exhaust into a two-effect crystallizer.

The question might immediately be asked. "Why can the third system justify so many more evaporators?" Good chemical engineering practice dictates that the addition of evaporators is justified on the basis of whether the operating savings of the additional effect are offset by capital investment. The additional capital investment is determined in accordance with mathematical relationship of Lindsey and Coston (*12*). As an LTV body is at least $2^1/_2$ times more expensive in stainless steel than in mild steel the relationship is obvious.

Assuming that spent liquors all enter with 12.5% concentration, that the ratio of water to organic material remains the same in the firing liquor, then evaporation economy is 3.4 lb. of water per pound of steam for system II to 40% solids and 6.0 for system III to 45% solids, and the economy of system I is 4.3 to firing concentration. System II seems to have an advantage over system I as far as process steam is concerned. However, it must be realized that the process steam arises from the recovery boiler after considerable quantity of the valuable available work has been extracted from it so that one can consider that the direct contact evaporation from 40 to 57% has reduced the production of the recovery boiler steam by 1 lb. for each pound of evaporation so that the actual steam used for evaporation could be considered an additional 1100 lb. per ton over the 4200 lb. required to take it to 45%.

A direct comparison cannot be made with the liquors from two-stage cooking for evaporation as the recovery of liquor from such a system employs the use of washers and a higher concentration of liquor to the evaporators.

In the preceding section, Fuel Value of Black Liquor Solids, it is shown that there is little difference in the net yield of heat to the furnace and boiler between the liquor treated by the Bradley process and liquor evaporated without treatment. Taking this into account, and from the discussion in this section, it can be seen that the WP recovery system can produce equivalent net steam to other sodium-base recovery systems.

THE RECOVERY TOWER OPERATION

The recovery tower which is used in the process has been a development within itself. It was considered necessary to prove out an efficient tower system in view of the total recovery of sulfur from the furnace gases. The design used was created from the pilot work of H. F. Johnstone and his students at the University of Illinois.

Possible use of this tower had many advantages.

1. The chemical theory and mathematics of operation were well developed.
2. The design promised an extremely low draft loss.
3. The simplicity of construction promised a low capital expenditure.
4. The "wetted wall" type of solution flow made it possible to eliminate entrainment with proper distribution.
5. The gas to liquor ratio is very high with this tower.
6. A 4 ft. height of a transfer unit would give high sulfur recovery for a reasonable height.
7. The low ratio of surface to gas flow reduces oxidation to a minimum.

Materials of construction were not well established. Johnstone and the Fulham Station of London had both used $^1/_4$-in. wooden slats, and reported success. Johnstone had used a wooden shell; whereas, the Fulham

station had used a rubber-covered steel shell. In neither case had the distributing system been worked out satisfactorily (*15, 16*). Upon the recommendation of the U. S. Plywood Association for use of Marine plywood the original construction used this material. Whether this material received a fair test or not could be argued.

In spite of a number of fire prevention systems, one fire occurred in the packing. The charring considerably weakened the shell. The burned-out plywood packing was replaced with clear Douglas-fir along with test pieces of Consoweld and polyvinyl chloride-soaked Douglas-fir. The Douglas-fir appeared to stand up. However, the warpage was very bad when the tower was inadvertently permitted to run dry. The lack of warpage of the Consoweld plus its wettability and strength has indicated that this is a satisfactory material. An inexpensive steel-supported stainless steel shell design has been created to eliminate wood entirely from the tower.

We have discussed this tower before. A considerable number of papers have been written on it (*13–18*). As the tower satisfactorily produced the required solution for the cooking liquor, this unit operation was studied last. Some study is still going on.

One of the problems under study has been the complete conversion of the sodium carbonate to sodium sulfite by mixing in the head tank. Physical chemistry indicates that this reaction goes to substantial completion. However, time is a factor.

Johnstone developed the theory of the sulfur dioxide vapor pressure of the sulfite-bisulfite solution as a ratio of the square of the bisulfite to the sulfite concentration. He did not take into consideration the change of activity with changes in concentration and with changes in ratio of sulfite to bisulfite which has recently been determined (*19*). In general, however, one factor remains constant. The vapor pressure of the solution is in direct relation with the pH.

There is a possibility of running the tower at too high a concentration of salts. Under these conditions sodium bicarbonate is precipitated and does not redissolve easily. More dilute solution will overcome this factor. However, there is a basic reason for running the tower with a concentrated solution. A bleed is taken from the bottom of the tower to process. The rest of the liquid is sent to the top of the tower. It can be shown that the material entering at the top of the tower is more alkaline in case a large bleed, dictated by a more dilute solution, is taken. While the more alkaline solution would reduce the sulfur loss slightly the alkalinity aids in retaining carbonate and sulfide ion in the solution entering the tower. The oxygen in the tower will react with the sulfide to form thiosulfate ion. Large amounts of carbon dioxide generated in the tower will cause bubbles which will break giving economically unretrievable entrainment in the tower.

One thing that should be noted about this tower or for that matter any recovery system in which the sulfur is all recovered from the flue gases is that 100% bisulfite cannot be produced in the tower. This is dictated by the vapor pressure of the sulfite-bisulfite mixtures. It is the usual rule that in order for the tower to have sufficient driving force for absorption, the partial pressure of sulfur dioxide in the gas at the bottom of the tower shall be at least one half again as large as the partial pressure of the sulfur dioxide over the scrubbing solution at the bottom of the tower. This establishes a limit of approximately 90% as sodium bisulfite at the bottom of the tower. With acid sulfite or bisulfite cooks the sodium enters the system in a ratio of 1:1 to the sulfur. It is obvious from this that the makeup sodium be the scrubbing solution, but that the makeup sulfur must be added to the solution after it leaves the scrubbing tower.

Under ordinary circumstances there is sufficient loss so that makeup base holds the proper sulfite-bisulfite ratio. It does not appear practical to wash the acid sulfite pulp to over 90% recovery of spent liquor. The situation is, therefore, of no particular consequence. However, if a very high combined bisulfite cook were used where the savings in chemical justified the use of elaborate stainless steel vacuum washers then in order to operate this type of sulfur recovery an overall loss of 10% sulfur would be required to operate with a recovery tower. However, in the normal case of acid sulfite operation where sufficient makeup is used, the 96 or 97% recovery of sulfur is to be obtained. Only in the case where the liquor enters with a ratio of sodium to sulfur of less than 1.1:1 do these remarks apply.

INSTRUMENTATION

The Consolidated Water Power and Paper Co. instrumentation of the experimental plant was designed so that the instrumentation for the process could be proved. All of the instruments were, therefore, established to handle the projected expanded plant. The equipment was made as flexible as possible so as to be able to change the instrumentation systems where indicated by changes in the process or instrumentation theories.

Some rather novel instrumentation systems have been experimented with. The most unusual has been the use of two Titrilogs for sulfur control.

A miniature, water-flushed precipitator treats 1 cu. ft. per min. of the outlet gases from the recovery tower. This removes the soda fume so that one of the Titrilogs may analyze the gases for sulfur dioxide content. The measured solution from this precipitator is analyzed with a spectrophotometer to accurately determine the stack loss of soda per hour.

The most disappointing factor in the instrumentation development is the apparent lack of a satisfactory, reliable, and inexpensive density primary element. Our original plan was to operate a completely automatic evaporator system, but the lack of satisfactory density element has precluded this.

Another place where our original planning has not been turned out in practice is in the boiler system, though this may be due to the small size of the furnace which we are using. We are using air flow-liquor flow ratio to control the combustion. This is fast becoming standard kraft practice. In addition we planned on re-setting this ratio by the oxygen analyzer on the furnace gases. One would ordinarily think that the combustion air should be decreased if the oxygen percentage should go up; however, this is not necessarily so. So far this resetting device is not satisfactory. Maybe a better application of automation

is to use this device as a control for the ratio of primary to secondary air.

The instrumentation has been discussed in another paper (*20*). It will be sufficient to say that the complete instrumentation for this recovery system has been developed. With this high degree of instrumentation which has been established, a large plant will require two men on the boiler and two men on the process including the final sulfiting of the cooking liquor.

MATERIAL BALANCE

One item of interest which has disturbed people looking at the flowsheet is the cyclic sodium sulfide. The question was asked: "What would you do if the sodium sulfide built up or disappeared?" The answer was that it didn't happen under normal operating conditions; that with the proper selection of a mixing ratio, and a small re-adjustment of the mixing ratio by pH control, the inventory of sodium sulfide mother liquor was held constant.

By following the results predicted from theoretical, laboratory, and recovery tests a method of positive control was established.

First, the inventory was increased to capacity. This was done by adding to the furnace sodium sulfate in greater amounts than would be returned from the precipitator catch. The sodium sulfate is converted almost completely to sodium sulfide.

Second, the inventory was rapidly depleted. This was done by adding part of the sodium sulfide mother liquor to the liquor going to the furnace. An extraordinary amount of sodium carbonate was produced in the plant. Soon the inventory of mother liquor was back to normal. It has been shown by laboratory and theoretical tests that during the charring of liquor with unconverted sodium sulfide sufficient carbon dioxide is released to convert the sodium sulfide to sodium carbonate. This releases hydrogen sulfide to the furnace gases. In the gas phase it is quickly converted to sulfur dioxide. For example, a heavy sugar syrup containing sodium sulfide produces an almost pure sodium carbonate ash when this liquor is charred and burned.

From these mill-scale tests and other work the following technique is established to control abnormal variations in the sulfide inventory: Increase the inventory by adding excess sodium sulfate to the liquor going to the furnace; decrease the sulfide inventory by adding part of it to the liquor going to the furnace.

This then establishes a method of using salt cake as the sodium and part of the sulfur makeup. The increase in sulfide inventory is counterbalanced by depleting the increase through sending it to the thick liquor. It should be reiterated that with normal operation, using sodium carbonate added to the tower solution, the inventory stays constant.

One item which seriously affected the plant balance was pump gland leakage. This factor would not be noticed in a large plant. The absolute difference in gland leakage between a small pump and a large one is small. The authors of a paper describing another small plant voiced the same complaint when discussing losses (*21*).

We solved this problem rather completely. The solution had the added advantage that the maintenance on the pump packings was greatly reduced.

Each rotary gland was equipped with a water ring between two series of packing rings. The water to each of these rings was passed through an inexpensive area meter. These meters read in gallons per hour. Depending on the shaft size one to ten gallons per hour flow is sufficient.

From the other side of the water ring a line with a valve goes to the sewer. This valve is opened enough so that there is a drip. In a few cases where the pump is handling hot solutions this flow is increased to also cool the gland.

In any case the packing gland is tightened to maintain the established flow in the meter. The up-stream side of this meter and gland has the full line pressure. The net result is that all glands have a controlled inward leakage of water. The drip is examined by color or feel to check for solution mixing with the seal water.

As the packings are all running cold and lubricated with water, it is no longer required to employ exotic packing materials. The dilution is limited to a tolerable amount by the flowmeter guides.

A practical closed system on the evaporator-crystallizer returns all of the condensates and receiver entrainment to the green liquor tank. This has eliminated constant and inadvertent losses from this source.

Entrainment in the foam of the black liquor evaporators has been no problem. York mesh in these evaporators and in an entrainment separator on the dissolver stack should eliminate entirely these two possible sources of loss.

Dreg washing is automatically accomplished in the thickener. However, it seems justifiable to filter the underflow of the thickener in a large plant for further loss reduction.

It has been demonstrated that the sewer losses can be reduced to 30 lb. per hour and that with an electrical precipitator stack losses can be reduced to 10 lb. per hour. Both these figures are in terms of sodium carbonate. For a plant of, say, 200 tons and the sodium loss of the collected liquor treated should be less than 2%.

SUMMARY AND CONCLUSIONS

Owing to an apparent need for an economic, sodium-base recovery system the WP recovery system was developed and placed in experimental commercial operation. Mill-scale tests plus commercial operation have established all of the factors required for the construction of future plants. The system differs little from that originally conceived.

Now the operation of the evaporator-crystallizer under vacuum permits an automatic unit operation for the separation of pure crystalline sodium carbonate monohydrate from the sodium sulfide of the smelt. Change of crystallizer operation dictates two sets of multiple-effect evaporators, a seven-effect kraft mild steel evaporator system for black liquor evaporation and a three-effect forced circulation system. The first of the triple effect concentrates the liquor from a feed of 45 up to 65% which is the firing concentration. The last two of this three-effect system are two bodies of evaporator-crystallizers under vacuum.

The overall heat economy in view of the multiple

effects permits this system to yield approximately as much steam as the most idealized justifiable sodium-base evaporation and burning operation; that is, there is no heat loss penalty for the process requirement of evaporating all of the water from the dissolved smelt during the operation of the process.

Under ordinary circumstances material balance is automatic. However, a control method has been demonstrated which permits sodium sulfide inventory adjustment if necessary. With this inventory control, sodium sulfate can be used as an entire makeup chemical.

Smooth furnace operation with a high degree of automation can be achieved. The shot cleaned air to gas air heaters not only has given excellent boiler efficiency; it has permitted excellent furnace operation without overfiring with auxiliary fuel even with very low B.t.u. content liquor solids.

The process-pump gland losses could be significant due to the high concentrations of sodium in the solutions to be handled. The measured flow, pressurized-gland technique has eliminated these losses entirely and reduced the pump gland wear to a negligible maintenance item. Combined with other techniques the results predict less than 2% loss of recovery on a large plant.

The sulfur dioxide recovery tower is capable of a 97% efficiency. By removing any traces of hydrogen sulfide from the solution in separate head tank the tower is operated without offensive odor. The theoretical vapor pressure relationships of Johnstone have to be modified and care must be exercised to complete the conversion of sodium carbonate to sodium sulfite.

Computations show that this process is probably the least expensive to install and operate of any of the full recovery systems. While a long range justification for soda base recovery is improved pulp quality, mills at 150 tons should not lose money on the investment. At 200 tons the investment shows a return that is about equal to those of the average paper mill investment. With larger tonnages the operation becomes very attractive indeed.

LITERATURE CITED

1. Boyer, R. Q., *Paper Industry* 41, No. 1: 177 (June, 1959).
2. Collins, T. T., Jr., *Southern Pulp and Paper Manufacture* 19, No. 1: 94 (January, 1956).
3. Boyer, R. Q., *Southern Pulp & Paper Manufacture* 20, No. 10A: 28 (October 10, 1957).
4. Drewsen & Dorenfeldt, U. S. patent 726,036 (April 21, 1903).
5. Boyer, R. Q., *Paper Mill News* 80, No. 12: 66 (March 23, 1957).
6. Boyer, R. Q., U. S. patent 2,862,887 (December 2, 1958).
7. Parrett, A. N., Private communication (1952).
8. Nugent, R. A. and Boyer, R. Q., *Paper Trade J.* 140, No. 18: 29 (April 30, 1956).
9. Nugent, R. A. and Boyer, R. Q., *Paper Trade J.* 140, No. 19: 30 (May 7, 1956).
10. Parsons, S. R. and Boyer, R. Q., *Tappi* 42, No. 7: 565 (July, 1959).
11. Bradley, Lynn, Private communication and data (1950).
12. Coston, M. M. and Lindsey, E. C., *Chem. Eng. Prog.* 52: No. 2: 49–52 (February, 1956).
13. Lessing, R., *J. Soc. Chem. Ind.* No. 57: 374 (1958).
14. Johnstone, H. F. and Singh, A. D., Univ. Ill. Eng. Exp. Bull. No. 324: 98–101.
15. Johnstone, H. F. and Singh, A. D., *Ind. Eng. Chem.* 29: 286–297 (1937).
16. Pearson, *et al.*, *J. Inst. Fuel*, No. 8: 119 (1935).
17. Learmonth, U. S. patent 2,056,429 (Oct. 6, 1936).
18. Johnstone, H. F., *et al.*, *Ind. Eng. Chem.* No. 30: 101–109 (1938).
19. Robert S. Morgan, Ph.D. Thesis, Institute of Paper Chemistry (July, 1959).
20. Taylor, J. W., "Instrumenting The Experimental WP Recovery Process," given at TAPPI Engineering Conference, Pittsburgh, Pa. (1959).
21. Scheid, L. J. and Coreaga, R., *Pulp and Paper* 33, No. 3: 59 (March, 1959).

Received May 10, 1960. Presented at the 45th Annual Meeting of the Technical Association of the Pulp and Paper Industry, held in New York, N. Y., Feb. 22–25, 1960.

DISCUSSION

Chairman McCarthy: Thank you very much. I think most of you are familiar in a general way with the process Bob Boyer has described, and the floor is now open for questions or comments.

John M. McEwen (Weyerhaeuser Co.): This morning we had some figures on the makeup and pounds per ton. Do you have some figures here on the pounds per ton sulfur makeup and pounds per ton soda makeup?

Mr. Boyer: Well, of course, this would depend entirely on the way you washed the pulp. I don't believe in stainless steel washers, quite frankly, and you people do.

I figure that our tests, for example, show that we can make about 80 to 85% recovery of the spent liquor in the pulp with blow pit washing. We have much cheaper evaporators. We can use more of them and the water does not hurt us, economically, so much.

Now, if you take the chemical going into the plant, I would state very specifically a 2% soda loss. Now let us assume 200 lb. of Na_2O per ton of moisture-free unbleached pulp, 2% of that would be, what—4 lb. As far as sulfur is concerned, it is about a 3% loss, we assume in the plant.

I would say there is nothing fundamentally wrong with any of these recovery systems being described. Of the chemical going into the plant they are all capable of making the same high recovery. I don't think you can compare the systems on the same number of evaporator effects. They will all do very well, depending upon how much money you want to spend. Actually, the sulfur loss is real, I mean, without treatment or other provision the acid evaporation really does only make an 80% recovery of sulphur going up to the tower. Does that answer your question? I am sorry to have hedged it.

Chairman McCarthy: Are there other remarks or comments relative to this process? Let me see if I understand you correctly. What you take out of the crystallizer is the monohydrate or the anhydrous salt?

Mr. Boyer: The monohydrate.

Chairman McCarthy: If there are no further questions, we will express our thanks to Mr. Boyer and proceed.

The next paper is a review of the sodium-base recovery—Mead Process, to be given by H. P. Markant of the Babcock and Wilcox Corp., Alliance, Ohio.

The Mead Recovery Process

H. P. MARKANT

This paper discusses the development of the Mead neutral sulfite recovery process that has led to its commercial application at two pulp mills—Mead Corp., Lynchburg, Va., and Watervliet Paper Co., Watervliet, Mich. A description is given of the process itself, the equipment required, and the steps involved in chemical conversion. The paper discusses some of the earlier operating problems and the manner in which they were solved, and reviews some of the latest developments now being tried in an attempt to make the process even more attractive.

Two SUCCESSFUL, commercial applications of the Mead neutral sulfite semichemical recovery process are opening new opportunities for the NSSC pulp ing industry. These operations were not without initial problems, some of which are attributable to normal startup and others to the need of continued development. The efforts and ingenuity of many people have culminated in a process that will economically handle all the residual digester effluent and, at the same time, recover 85% of its sodium and sulfur content.

Originally developed by The Mead Corp., the pilot studies of the process carried out at its Sylva mill* led to the commercial installation (50 tons per day of NSSC pulp) at Watervliet Paper Co. in Watervliet Mich.**. Shortly thereafter, a second installation, sized for producing 250 tons of unbleached corrugating medium, was placed in operation at Mead's Heald Division in Lynchburg, Va. The purpose of this paper is to present the story of the development of the process and to show you that:

1. The Mead process is now *no longer a pilot process*, but a commercial reality.
2. The addition of more contact surface in the absorption system has reduced the odors from the process and brought them within acceptable limits. The hydrogen sulfide concentrations are now less than 0.01%.
3. The improvements in the venturi scrubber and the installation of a droplet agglomerator in the sulfiting tower have reduced the amount of particulate matter leaving the process to an extremely low level.
4. Furnace stability and reduction of chemicals have been improved by preheating combustion air. No supplementary oil is required and the reduction has averaged 90 to 92%. Other improvements and further refinements that are still in progress should make the process even more attractive.

PROCESS AND EQUIPMENT

The liquor from the digester in the neutral sulfite recovery process at approximately 12% solids is drained from the softened chips and run into a weak liquor storage tank. Next, the chips are removed from the digesters and put through a rough refining operation followed by a multistage vacuum washing operation. The liquor removed during this step is run into the weak liquor storage tank. The chips then go to the papermaking process and are no longer a part of the recovery process.

The weak liquor is concentrated in multiple-effect evaporators to about 50% solids and stored in the strong liquor storage tank.

From the strong liquor storage tank (Fig. 1), liquor is pumped into the venturi scrubber where it is contacted with hot furnace gas. The gases are scrubbed free of the particulate matter while, at the same time, additional water is evaporated from the liquor to a concentration of 65% solids. It is then pumped to the furnace.

The liquor is handled in a conventional furnace of the kraft type rated at 108 kraft tons, or 250 NSSC tons per day, at 1600 lb. of dry solids per ton. The boiler produces 38,700 lb. of steam per hour at 600 p.s.i. and 750°F. total temperature.

Smelt from the furnace is dissolved in a conventional kraft dissolving tank with the concentration maintained at between 5 and 6 *N*. The liquor is then put through a conventional clarifier and dregs washer.

Up to this point, the process is the same as in kraft practice; but from here on, the novel features of the Mead process are utilized.

CHEMICAL CONVERSION (ABSORPTION SYSTEM)

Before considering in detail the type of equipment used in the process of chemical conversion, it is best to describe the basic stages and general chemistry. On Table I are shown the two basic stages—total carbonation and sulfiting—as well as other predominant reactions. In the *total carbonation* stage, the Na_2S and Na_2CO_3 are converted to a solution composed chiefly of Na_2CO_3 and $NaHCO_3$, and sulfur is released as H_2S, which is returned to the furnace and burned to SO_2. In the *sulfiting* stage, SO_2 is absorbed as shown. The equipment for these stages is shown schematically on Fig. 2.

The green liquor from the storage tank is fed to the precarbonation tower where it comes in contact with about 15% of the total gas in the carbonated tower system. When the gas enters the precarbonation tower, it contains H_2S that was released in the carbonation system; but the H_2S is reabsorbed by the incoming green liquor and H_2S-free gas is discharged to the atmosphere at the outlet.

The precarbonated and partially carbonated green liquor at the bottom of the precarbonation tower has absorbed hydrogen sulfide to the extent that all the

H. P. MARKANT, Research Engineer, The Babcock and Wilcox Co., Research Center, Alliance, Ohio.

* The Mead Recovery Process, by J. Campbell, Babcock & Wilcox Co., and P. E. Schick, The Mead Corp., presented at the Alkaline Pulping Conference of TAPPI, Nov. 5, 1956.

** New Recovery Process, by L. J. Scheid, Watervliet Paper Co. and R. Careaga, Babcock & Wilcox Co.—*Pulp and Paper* (March, 1959).

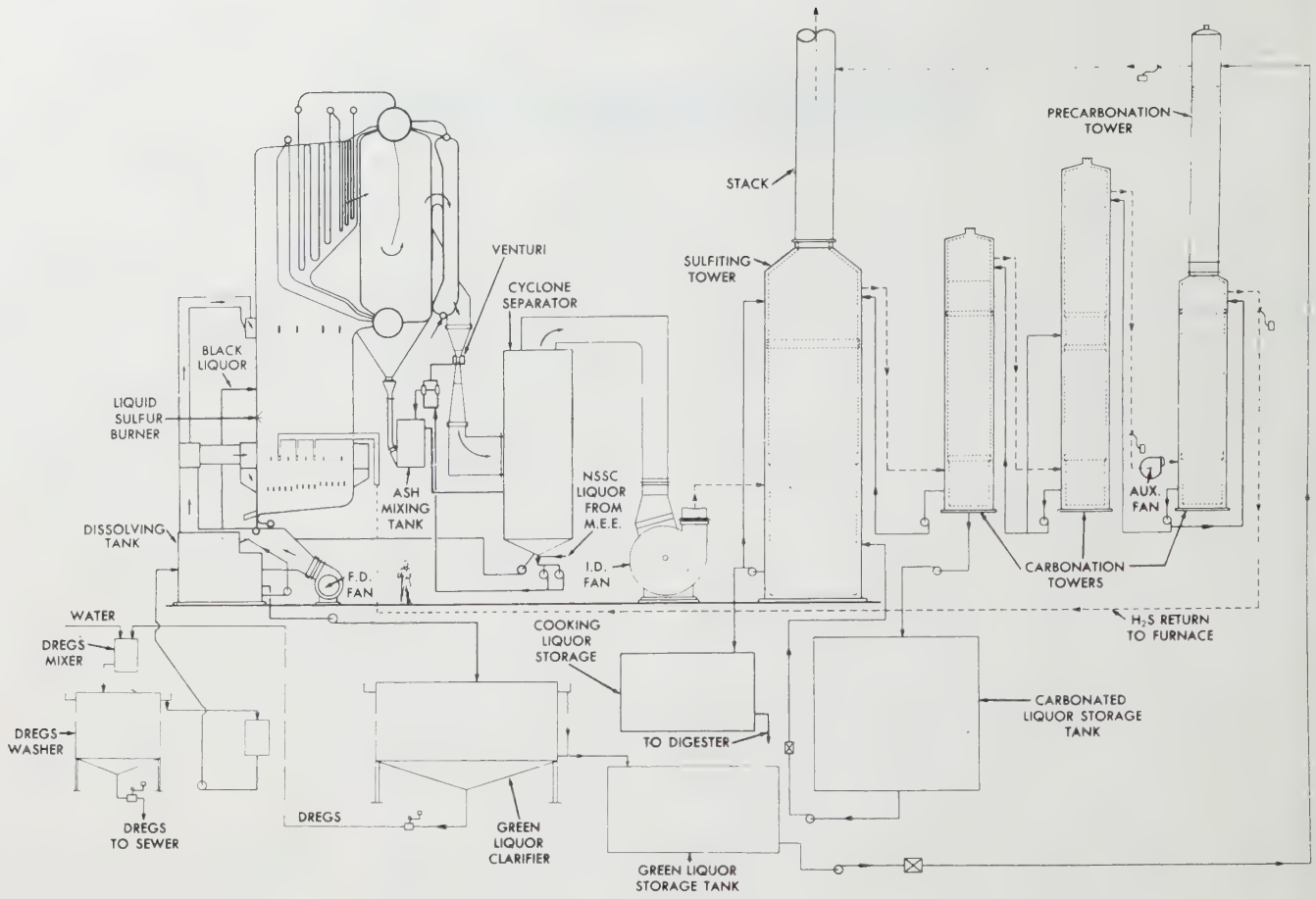

Fig. 1

sodium sulfide present in the incoming green liquor has been converted to sodium hydrosulfide. Under this condition, liquor attains its maximum hydrogen sulfide vapor pressure, and it is at this point that the hydrogen sulfide content of the flue gas is at its maximum. The gas is tapped off and returned to the furnace.

The precarbonated liquor is now passed countercurrent to approximately 30% of the flue gas from combustion in a series of tile-lined carbonation towers packed with drip-grid tile. In these towers, the liquor absorbs carbon dioxide and releases hydrogen sulfide, and the gas loses carbon dioxide and gains hydrogen sulfide. The hydrogen sulfide content of the gas returned to the furnace is, therefore, approximately 4% by volume. The carbonated liquor leaving this system contains only a small quantity of unreacted sulfur. It is stored in a large tank to permit out-of-phase operation of the furnace and absorption system.

Table I. Chemical Reactions Mead Process

Total Carbonation

1. Precarbonation
   $Na_2S + H_2S \rightarrow NaHS$
   $2Na_2S + CO_2 + H_2O \rightarrow Na_2CO_3 + NaHS$
2. Carbonation
   $2NaHS + H_2O + CO_2 \rightarrow Na_2CO_3 + 2H_2S$
   $2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$
3. Final Carbonation
   $Na_2CO_3 + H_2O + CO_2 \rightarrow 2NaHCO_3$

Sulfiting

$SO_2 + H_2O \rightarrow H_2SO_3$
$H_2SO_3 + 2NaCO_3 \rightarrow Na_2SO_3 + 2NaHCO_3$
$H_2SO_3 + 2NaHCO_3 \rightarrow Na_2SO_3 + 2H_2O + 2CO_2$

The next phase of the process takes place in a sulfiting tower, approximately 12 ft. in diam. and 45 ft. high, packed with drip-grid tile. Here the SO_2 in the flue gas leaving the venturi scrubber cyclone separator is scrubbed with the carbonated liquor.

Makeup sodium is added to the system in the sump of the tower in the form of sodium carbonate. This controls the pH at approximately 8.2 so that an Na_2SO_3 ratio of 4.5 to 1 is obtained. The sulfur makeup is added by burning molten sulfur in the recovery furnace, using a Y-jet steam atomizer. Typical plant liquor compositions are shown in Table II.

OPERATING EXPERIENCE

During the early stages of operation, as can be readily understood, the sodium and sulfur recovery efficiencies based on total sodium and sulfur to the digester were low. More recently, however, recovery efficiencies of 80% sodium and 85% sulfur have been obtained. These correspond to a chemical makeup of 150 lb. of Na_2CO_3 per ton of pulp and 30 lb. of sulfur.

The approximate distribution of chemical losses in percentages based on total sodium and sulfur charged to the digesters is shown on Table III. It is entirely conceivable that these losses can be reduced to 10% as operation is improved and further development takes place.

A very significant point in favor of the operation of this process is that, by giving the operators additional tools in the form of improved instrumentation, it can be satisfactorily controlled by two men. Black liquor flow to the furnace is continually recorded and adjusted

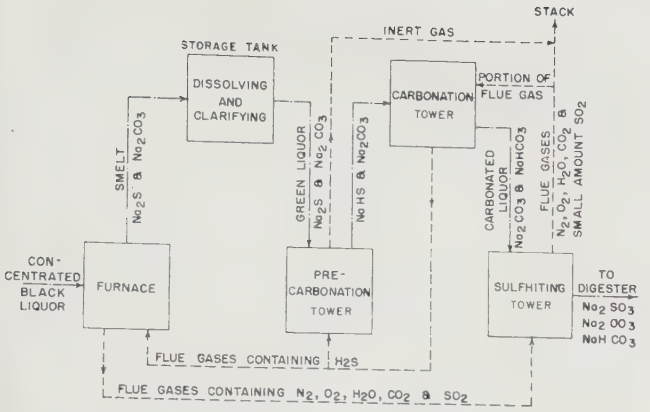

Fig. 2. Schematic diagram of Mead NSSC recovery process

by means of a magnetic flowrator. Black liquor solids to the furnace are automatically controlled and adjusted by up-to-date instruments of the radioactive-source type.

The recovery furnace has been provided with an automatic gas burner located in the air duct that supplies combustion air to the furnace. Preheating combustion air to at least 450°F. has greatly improved furnace stability, and this in turn has meant less supervision by operating personnel. Supplementary oil is now used only during periods of startup and shutdown. As a result, supplementary fuel costs have been decreased from $1.00 to $0.25 per ton of pulp.

As was mentioned earlier in the description of the process, the gas flow from the carbonation system is split between the furnace and the precarbonation tower. As much gas is forced to the percarbonation tower as will go through without releasing H_2S from the outlet of the tower. This is checked by taking a continuous sample of gas from the exit of the tower to the control room where it is bubbled through a lead acetate solution. The method has proved extremely effective without imposing undue hardships on the operating personnel. The total stack gases are continuously monitored for SO_2 and H_2S, and concentrations are not allowed to exceed 0.03 and 0.01%, respectively. Continual efforts are being made to further decrease these levels, although at present the general concentrations from the Mead process are approximately those of established kraft experience.

In the engineering of the two Mead process installations, special design precautions were incorporated in the process in considering the release and transfer of hydrogen sulfide gas. The operating experience has confirmed the sound engineering of the hydrogen sulfide system. Just as the pulp and paper industry has developed techniques to handle other toxic gases, the Mead process, which incorporates release of hydrogen sulfide gas, has been operated without problem.

In the early stages of operation, this process was not without its share of problems. The major source of difficulty contributing to higher-than-desired H_2S concentrations leaving the process was a deficiency in absorption tower capacity. The problem was one of having to operate an overloaded absorption tower to prevent stream pollution. This meant that residual sodium hydrosulfide (NaHS) in the carbonated liquor was abnormally high, causing H_2S to be released to the

Table II. Typical Composition of Plant Liquors Mead Corp.

Typical Analysis of Process Liquors

Liquor compositions expressed as per cent of total sodium

Typical Black Liquor to Furnace—Oak

Concn.	60–65% solids to furnace
Gross heating value	5000 B.t.u./lb. (dry solids)
Na_2O	19%
Sulfur	12%

Components	*Green liquor (smelt in H_2O)*	*Carbonated liquor*	*Sulfited liquor*
Na_2CO_3	38	70	20
$NaHCO_3$	0	15	0
Na_2S	54	0	0
NaHS	1	2	0
$Na_2S_2O_3$	3	6	11
Na_2SO_3	0	0	60
Na_2SO_4	4	7	9
Total	100	100	100

stack from the sulfiting tower. This would parallel conditions in an overloaded kraft recovery unit. As the liquor input overbalances the amount of available combustion air, which is sometimes necessary to avoid stream pollution, the problem then becomes one of air pollution. It was, therefore, necessary to install additional carbonating surface to handle the quantity of liquor sent to recovery from the pulp mill. This change has corrected the difficulty.

Another problem that caused considerable nuisance and loss to the process was the discharge of Na_2CO_3 particles in the stack gas. A series of tests showed that the venturi-scrubber cyclone-separator was performing as expected (outlet dust loading less than 0.2 grain per standard cubic foot), and that the source of the difficulty was the entrainment of liquor at the top of the sulfiting tower. This problem was solved by redesigning the liquor distribution system in the tower and installing a droplet agglomerator of the wire-mesh type that would increase droplet size and prevent particle discharge from the stack.

The liquor and gases handled throughout the system were known to be quite corrosive through a materials test program undertaken during the initial pilot studies. By and large, the choice of materials was good, but corrosion was still a problem in some parts of the system, especially in the carbon steel duct work from the cyclone separator to the induced draft fan and the Cor-Ten housing of the fan itself. Since these areas could not be protected by coating with coal-tar epoxy resins, they were replaced with stainless steel type 316 material.

The field studies on better, lower cost materials and coatings have continued. Several dozen test specimens placed at critical corrosion points in the system

Table III. Sodium and Sulfur Losses, Mead Corp., Lynchburg, Va.

	Na and S loss, %
Pulp	6.0
Dregs	2.0
Evaporation	2.0
Stack	0.3
Extra black liquor storage	1.0
Miscellaneous washer building loss	1.0
Miscellaneous recovery building loss	1.0
Washup and weak liquor filter	1.7
Total	15.0

have been evaluated, some of which show considerable promise. In the near future, it is planned to install sections of ducts with flanges of several of the most promising materials so they can be evaluated under field conditions.

The process, as it now stands, has reached a stage of development where it represents a definite contribution to the further growth of the neutral sulfite pulping industry. This happy situation is due to the contributions of a great many people—far too many to mention individually. They include many employees of the Mead Corp., Watervliet Paper Co., and the Babcock and Wilcox Co.

Further refinements to the equipment and even better control of stack discharge will make the process still more attractive by decreasing capital cost and improving overall efficiency. Some of these studies are already under way and others are expected to start in the near future. At the present time, they include:

1. Making a complete heat and chemical balance on the recovery process, exclusive of the pulp mill. From the overall high sodium and sulfur recovery efficiencies that are being obtained, the recovery process is expected to show efficiencies in the order of 95%.

2. Studying the possibility of still further lessening the odor by lowering the SO_2 and H_2S levels. This is being done by evaluating commercial equipment designed for this purpose and investigating several novel ideas on process refinement that may be incorporated into the basic process.

A report will be made at some later date as these new developments become a reality.

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DISCUSSION

Chairman McCarthy: Thank you very much. Are there now any questions from the floor?

Sydney Coppick (Scott Paper Co.): In this is the high thiosulfate content of the recovery system inherent in the system or can something be done about that?

Mr. Markant: The high thiosulfate content actually comes from two sources. As you know, we get an increase in thio in the carbonation system. We get some percentage of increase here. There is an additional increase in thiosulfate in the sulfiting step, and this thio increase occurs when one has residual hydrogen sulfide in the residual liquor leaving the carbonation system.

Question: This is directed toward neutral sulfite recovery. Is it possible to process in this fashion for acid sulfite?

Mr. Markant: We have not gone to bisulfite in the commercial installations. We have, however, processed on a small-scale absorption tower studies and also studies on absorption in the venturis pattern, and we believe that it is possible to go to bisulfite in the Mead process. We have not, however, commercially proved it.

Question: What would be just the elementary aspects of change of procedure?

Mr. Markant: Well, it would be by adding sulfur in the sulfiting tower.

Chairman McCarthy: Many thanks to you, Mr. Markant, for an interesting and informative paper. We have one more presentation on the program. However, I think it might be a good idea to have a five-minute recess right now.

* * *

Chairman McCarthy: Gentlemen, let us proceed to our next paper.

For the last several years in Sweden there has been in operation a sodium base sulfite pulp mill which is certainly of much interest with regard to the topic under discussion here today. We are fortunate indeed to have several gentlemen associated with this company here. Dr. Cedarquist will present the paper.

Stora Sodium-Base Chemical Recovery Process

K. N. CEDERQUIST, N. K. G. AHLBORG, B. LUNDEN and T. O. WENTWORTH

A survey is made of the work on recovery of sodium and sulfur in the sulfite mill of Stora Kopparbergs Bergslags AB at Skutskar, Sweden, and covers the period from World War I till now. The paper deals with a number of alternatives to carry out a recovery of the chemicals in the pulping acid. The simplest solution of the problem represents a combination of a sulfite mill and a kraft mill in which the smelt from the sulfite mill is used as makeup chemicals in the kraft mill. Separation of sodium carbonate and sodium sulfide in the smelt by crystallization of the smelt solution or by extracting the crushed smelt with hot water is discussed. Further different methods are discussed to separate sodium and sulfur by carbonating and vacuum stripping of the smelt solution. The recovery process in the mill at Skutskar is described in detail: the smelt solution is carbonated and stripped in one stage by treating the smelt solution at elevated temperature counter-current to a stream of pure carbon dioxide in a tower. The leaving mixture of carbon dioxide and hydrogen sulfide is completely freed from hydrogen sulfide by a Claus reaction, and the purified carbon dioxide recycled to the tower. The process is self-sustaining of carbon dioxide and operates with a high recovery yield and a minimum of thiosulfate formation. The chemicals are recovered as sodium sulfite and sodium bisulfite.

During the first World War, the extremely high price of coal in Sweden made it highly desirable to utilize the organic substance available in waste liquors from sulfite pulp mills as fuel. This stimulated an extensive research in our mill in Skutskar, in problems concerning evaporation and burning of sulfite waste liquor. At that time, however, the major problem was to keep the evaporator from scaling. To minimize this trouble, it was decided to change from the insoluble calcium base to the soluble sodium base.

K. N. Cederquist, N. K. G. Ahlborg and B. Lunden Stora Kopparbergs Bergslags, A.B., Sweden; T. O. Wentworth, Chemical Processes, Inc., Cincinnati, Ohio.

Immediately after the War, coal prices went down appreciably and the burning of spent liquor, primarily for heat recovery, lost some of its importance. During this same period, our laboratory had learned many interesting facts about pulping with sodium-base liquor, and this work has continued, with minor exception, ever since.

An economic use of sodium base requires a good recovery of heat and chemicals, and therefore it has been of primary interest at all times to develop a simple and economical recovery method.

As early as 1920, we knew that, after evaporation, sulfite spent liquor could be burned like kraft liquor, and that the smelt consisted mainly of sodium sulfide and sodium carbonate. This smelt could, therefore, be used for makeup in a kraft mill. A combination of the sulfite and sulfate processes therefore represents a simple and economical solution of the re-use of the chemicals. It is obvious, however, that the sulfate mill must be of a certain minimum capacity in relation to the sulfite mill in order to fully utilize the chemicals from the latter.

Such a recovery process was actually operated on a pilot-plant scale in the mill during the period 1930 to 1935. This plant separated sodium carbonate from the smelt solution by crystallization. During the earlier period of the sulfate pulp industry, it was generally thought that the higher the sulfidity, the better the resulting pulp. Based on this belief, we mixed smelt solutions from the sulfate and the sulfite mills, following which we cooled the mixture with slow agitation. By doing so, part of the sodium carbonate crystallized and could be separated. The crystallized product was used for acid-making in the sulfite mill, and the mother liquor, now enriched in sodium sulfide, was used for making cooking liquor in the sulfate mill. However, it proved very difficult to handle the hydrated crystalline mass and, therefore, we looked for another alternative. We finally fixed on a method whereby we cooled the smelt and then crushed it, following which it was dissolved in a fixed quantity of 90°C. water. All of the sodium sulfide could be extracted in this manner, leaving a residue which consisted mainly of anhydrous sodium carbonate which was quite easy to wash and to handle. We had quite a lot of difficulty with the discharging and cooling of the smelt, but it might be possible to further develop this method so that it could be used on a commercial scale.

Simultaneously, an investigation was going on, designed to improve the quality of the sulfate pulp by using cooking liquor of an extremely high sulfidity in a two-stage cooking process. This, however, did not give good results and both of these recovery and cooking methods were abandoned.

Throughout this period it became increasingly apparent that we needed a recovery system which would be independent of the sulfate mill; and, in 1940, we finally completed a full-scale unit to do this job. We used a mixture of carbon dioxide and flue gas for carbonating the smelt solution. Hydrogen sulfide was then stripped from the carbonated solution by heating it with steam in a vacuum column. The escaping gases—consisting of hydrogen sulfide, carbon dioxide, and water vapor—passed through a condenser, where part of the vapor was condensed. The remaining gases then passed to a burner and were burned to sulfur dioxide. We operated this unit for many years, but we had underestimated the problems caused by the formation of excessive quantities of thiosulfate and polythionates. Finally, in order to avoid this difficulty, we had to rebuild the system in such a way that we could recover the active sodium as crystallized bicarbonate, thus making it possible to separate it from the thiosulfate and polythionates.

The carbonation was carried out in two stages, and between the stages hydrogen sulfide was stripped off. In the first stage, the solution was carbonated to the limit of sodium bicarbonate solubility. In the second stage, the carbonation was continued until a maximum yield of bicarbonate precipitated. Carbon dioxide for the carbonation was, in the first stage, a mixture of pure carbon dioxide and flue gas; and, in the second stage, a more concentrated gas containing 80 to 90% CO_2.

The mother liquor containing the thiosulfate and polythionates was returned to the boiler for reconversion to sulfide and carbonate. This system was also in use for several years. This system gave a pure cooking acid very free of thiosulfate. However, the excessive quantity of re-cycled chemicals resulted in lowered boiler efficiency and increased chemical loss.

The important task was to avoid the formation of thiosulfate, and we found that this could be accomplished only by using oxygen-free carbon dioxide. In this way, a pure sodium carbonate solution could be made and, at the same time, the quantity of recycled chemicals could be kept low.

Another point of major economic importance was to recycle carbon dioxide and to offset any losses from the system with the combined carbon dioxide entering in the smelt—even when the sulfidity is high and the quantity of combined carbon dioxide correspondingly low.

In our pilot-plant work, it was established that if the sulfidity was not higher than 50 to 60%, the combined carbon dioxide would safely cover the losses in a two-stage carbonating system in which the smelt solution was carbonated in the first stage under a slight pressure in a closed tower, followed by an incomplete expulsion of the hydrogen sulfide by stripping the solution under vacuum. The stripped solution was cooled and recarbonated in a second stage, after which the remaining hydrogen sulfide was expelled countercurrently in a tower by a stream of carbon dioxide which thereafter was re-used in the first stage.

When the resulting sodium bicarbonate solution was reacted with sodium bisulfite, carbon dioxide was again liberated and in sufficient amount to cover the requirement in the carbonation steps. However, when the sulfidity was higher than 60%, the carbon dioxide bound to the smelt did not suffice to cover the CO_2 losses. In fact, the same problem arises in all systems using vacuum stripping units.

Our experimental work showed conclusively that by proper operation of the recovery boiler, and by decreasing the quantity of recycled chemicals, the sulfidity will be above 75% and the formation of thiosulfate will be on the order of 1% of the total active alkali. However, some further oxidation does take place after the recovery boiler, and this results in a

somewhat higher thiosulfate concentration. In our mill, the final thiosulfate concentration ranges between 1 and 2%. Such further oxidation occurs in the process of discharging and dissolving the smelt.

To minimize carbon dioxide losses to the point that the system could be self-sustaining even at high sulfidities, the process was redesigned so that the smelt solution was carbonated and stripped countercurrent to a stream of pure carbon dioxide in one operation at atmospheric pressure and elevated temperature. The mixture of hydrogen sulfide and excess carbon dioxide leaving the reaction tower was then completely separated so that pure carbon dioxide, free from oxygen, was available for recycling to the carbonating tower.

This system has been in successful full-scale operation for several years in the Skutskar mill and for one year in the sulfite mill of Mo och Domsjö at Ornskoldsvik, Sweden. This final system will be described below:

The system comprises four main sections:

1. The carbonating and decarbonating towers for carbonating and stripping the smelt solution and for converting the obtained sodium carbonate-bicarbonate solution to sodium sulfite.

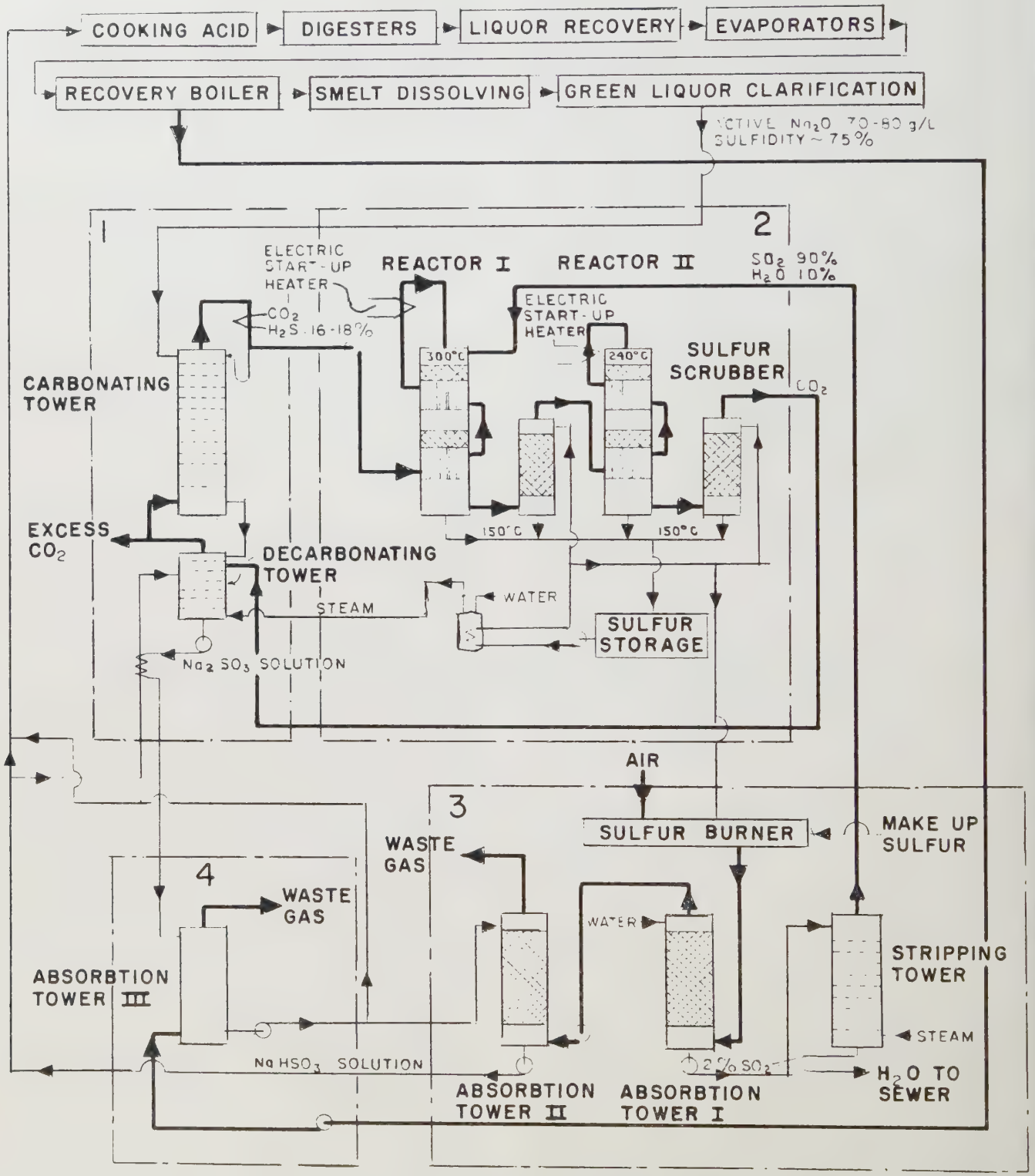

Fig. 1. Stora sodium-base chemical recovery process

2. The Claus-reactors, where the carbon dioxide is freed from hydrogen sulfide by conversion of the latter to elemental sulfur.
3. The units for producing and concentrating sulfur dioxide.
4. Scrubbers for absorbing sulfur dioxide from the boiler flue gas.

The system operates as follows: Smelt from the boiler is dissolved in water, the resulting concentration being 100 to 130 g. of active Na_2O per liter with a sulfidity of about 75%. The solution is clarified by settling and then continuously diluted to 70 g. Na_2O per liter.

Prior to the main carbonating tower, this liquor is passed through a smaller vessel, where it is precarbonated. Because of the lowered pH, some scaling occurs in this tower, which is one of the reasons for its use. Furthermore, hydrogen sulfide is more readily stripped from the solution in the main carbonating tower if initial carbonation takes place externally. This results in a tower with fewer trays and less height.

The requisite quantity of pure carbon dioxide is fed to the bottom of the carbonating tower. This consists entirely of carbon dioxide re-circulated from the top of the tower through the Claus-reactor, together with the carbon dioxide liberated in the decarbonating tower by the conversion of sodium carbonate-bicarbonate to sodium sulfite.

The feed liquor termperature at the top of the tower is kept at 70 to 75°C. The gas leaving the top consists of water vapor, carbon dioxide and 16 to 18% hydrogen sulfide calculated on a dry basis. By cooling the gas to 40°C. most of the water is condensed and the remaining gas passes through a rotary blower to the gas purification unit. This is a modified Claus-reactor system, where hydrogen sulfide is converted to elemental sulfur.

The Claus unit consists of two vertical reaction towers in series. Each tower has two catalyst beds and two preheaters. In the beds, the hydrogen sulfide is reacted with sulfur dioxide to form water vapor and elemental sulfur. The reaction is exothermic and the liberated heat is transferred in the preheaters to the ingoing gas. The first reactor uses a higher temperature for fast reaction; the second reactor has a lower temperature for more complete reaction. The catalyst in the second reactor has a higher activity than the lower-cost catalyst in the first reactor.

After each reactor, there is a scrubbing tower, where the outgoing gas is washed with liquid sulfur for the removal of gaseous and sublimated sulfur. The liquid sulfur, circulating through the scrubbers, enters at 135 to 140°C. and leaves at about 150°C. The circulating sulfur is then cooled in a heat exchanger and the heat is used to produce steam, which, in turn, is used to heat the decarbonating tower. Excess sulfur is pumped to the sulfur burners.

The equilibrium concentrations of hydrogen sulfide, sulfur dioxide, and sulfur resulting from the Claus reaction are influenced by the relative quantities of these constituents and by the water content and the temperature. It is desirable to keep the reaction temperatures as low as possible for the most favorable equilibrium conditions. The reaction cannot be completed in one step, particularly since it is desired to keep excess sulfur dioxide as low as possible. Therefore, the reaction is performed at the lowest possible temperatures and in several steps with intermediate cooling and removal of elemental sulfur.

The cooled carbon dioxide, hydrogen sulfide gas mixture from the carbonating tower is preheated to about 300°C. after which it is mixed with an adequate amount of sulfur dioxide prior to entering the upper catalyst bed in the first reactor. After passing the lower bed and a washing stage, the gas, now much poorer in hydrogen sulfide, enters the second stage after preheating to 240°C.

In our method of operation of the sulfur recovery system, the conversion of hydrogen sulfide to elemental sulfur is for all practical purposes complete, and the carbon dioxide leaving the system can be recycled to the base of the carbonating tower without further purification.

The Claus-reactor produces elemental sulfur which, together with makeup sulfur, is fed to a sulfur burner for producing sulfur dioxide. The burner gas passes through a scrubber, where part of the sulfur dioxide is absorbed in 12°C. water, forming a 2% solution of sulfur dioxide. In a second tower, sulfur dioxide is stripped from the aqueous solution. Water is removed in a partial condenser, yielding a gas for re-cycle which contains approximately 90% sulfur dioxide and 10% water.

The balance of the burner gas, not absorbed in the water scrubber, passes from the top of the scrubber to a second absorption tower, where sulfur dioxide is absorbed in a sodium sulfite-bisulfite solution, producing a bisulfite solution.

This bisulfite solution leaves the absorption tower with about 70 g.p.l. Na_2O and is now used in the decarbonating tower to convert the sodium carbonate-bicarbonate solution to sodium sulfite. This sodium sulfite solution is used in the absorption tower for the recovery of sulfur dioxide from the recovery boiler gas. The bottom section of the decarbonating tower is heated by steam in order to facilitate the removal of carbon dioxide. Sodium sulfite and sodium bisulfite can be used as desired for making a cooking acid of suitable pH.

The absorption tower, for scrubbing sulfur dioxide from the boiler flue gas, must be very carefully designed and operated in order to prevent formation of sulfate. The contact time should be short and the sodium sulfite concentration on the high side. Even so in our operation, from 10 to 20% of the recovered sulfur is oxidized to sulfate.

The resulting solution of sodium sulfite and bisulfite from the flue-gas scrubber is used for the absorption of sulfur dioxide from the burner gas as previously described.

Features of this recovery system which are of particular importance are the high recovery yield of chemicals, and the trace formation of sodium thiosulfate. In addition, this system, dealing as it does with only gases and liquids, lends itself ideally to continuous operation and fully automatic control.

As previously mentioned, the system comprises four sections:

1. Carbonating and decarbonating towers.
2. Claus-reactors.
3. Units for making and concentrating sulfur dioxide.

4. Absorption towers for recovering sulfur dioxide from flue gas.

By the proper operation of these four sections, the formation of thiosulfate is limited to approximately 1% of the total amount of active Na_2O. It has been proved, however, that a content of 4 to 5% thiosulfate has no appreciable influence upon the pulping process, and therefore we have not found it necessary to remove the small quantity of elemental sulfur which remains in the gas leaving the Claus-unit. This sulfur is absorbed in the decarbonating tower with some increase in the thiosulfate concentration. However, the final concentration in no instance exceeds 4%.

There is no loss of chemicals in the first two sections. The yield of ingoing and outgoing chemicals is practically 100%.

In the third section, 4 to 5 kg. of sulfur per ton of pulp is lost, and, in the fourth section, approximately an equal amount.

A small loss of sodium also occurs in the absorption systems, but this does not exceed 2 to 3 kg. Na_2O per ton of pulp, and may be considered as normal in this type of processing.

The principal losses of chemicals in the sulfite mill occur during blowing the digesters, in the washing of the pulp, in the evaporation, and in the combustion. The overall yield of chemical recovery is closely dependent upon the performance of these four stages of the pulping process and is affected only to a small extent by the specific recovery process which has been described.

A flow diagram of the Stora sodium-base chemical recovery is given in Fig. 1.

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Chairman McCarthy: I think with no intermediate discussion at all, we will ask Axel Scholander of the Mo och Domsjö A.B. in Sweden, where an installation of this type has been built and is now operating, to proceed with the rest of this paper.

The Stora Kopparberg Recovery Process in the Mo & Domsjö AB Domsjö Sulfite Mill

AXEL SCHOLANDER

A background to the conversion of the Domsjö sulfite mill to sodium base cooking is given. Some experiences from the startup and the operations of the pulping and the recovery system are described. The all-liquid process is well adaptable to instrumentation and regulation. No odor problems have arisen.

As a supplement to Mr. Cederquist's paper I want to give you a little background to Mo & Domsjö's conversion of our Domsjö mill to sodium base sulfite. This mill is situated in Northern Sweden and produces a total of 330 to 350 ton per day dissolving pulp.

Our interest in sodium dates back to the middle of the 40's when Samuelson studied sodium-base cooking and also applied for patents concerning recovery. In 1950 we needed a new boiler and, having an evaporation installation, we decided to build the new boiler so that it could be re-built into a sodium-base recovery boiler later, if necessary. In 1951 we also contacted Stora and had a look at their process at that time, but didn't like the crystallization system very much. We had to be absolutely sure of the quality of our cooking acid and that could easily be reached with the pure bicarbonate, which was recovered, but on the other hand we had no sulfate mill in the immediate neighborhood where we could discard undesirable mother liquors if the system got out of balance. So we made further studies on cooking with different bases and recovery processes. In 1955 a study trip was made to the United States and after that we were convinced that for our part sodium would be the ultimate solution giving a complete degree of freedom when it came to cooking, and at the same time making chemical recovery possible.

In 1956 a new boiler was planned and new contacts with Stora showed that they had a new process in mind and worked out in the pilot plant, the same as was shown by Mr. Cederquist. So we signed an agreement licensing us the process. We started planning and building a boiler, increased the evaporation capacity and started projecting the recovery plant.

In its main features our recovery plant is the same as that at Skutskär, although we do not have any flue-gas scrubber installed as yet.

Sodium-base cooking started in the mill on July 7, 1959, and about a week later the first cooks made on recovered acid were blown. So far we have only made conventional one step acid sulfite cooking. We have two stage cooking in mind and are building for that right now.

The startup went smoothly—we have so far not lost any production due to chemical process faults, but to start with, we had some troubles in the rest of the mill with leakage through joints and flanges which had been tightened by calcium scaling, which slowly dissolved in the sodium-base liquors.

In the digester house, circulation of liquor has increased due to absence of scaling of our strainers and more rapid cooking is possible. Screenings are considerably lower than before. Screenings resulting from surface-damaged wood have practically disappeared.

No changes have been made in washing, liquor collection or alcohol plant. Evaporation is run in three counter-pressure stations of the Rosenblad switching

Axel Scholander, Assistant Technical Manager, Mo & Domsjö A.B., Örnsköldsvik, Sweden.

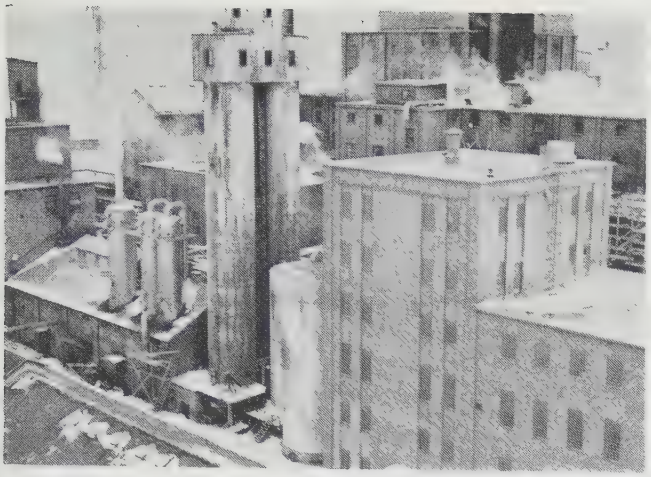

Fig. 1. Mo och Domsjö—Domsjö mill; an overall view of the recovery system

Equipment from left to right, foreground: pyrite roasting, bisulfite tower, SO_2 water preparation, raw acid tower, old Jensen towers, bisulfite liquor tank, Claus department, recovery house.

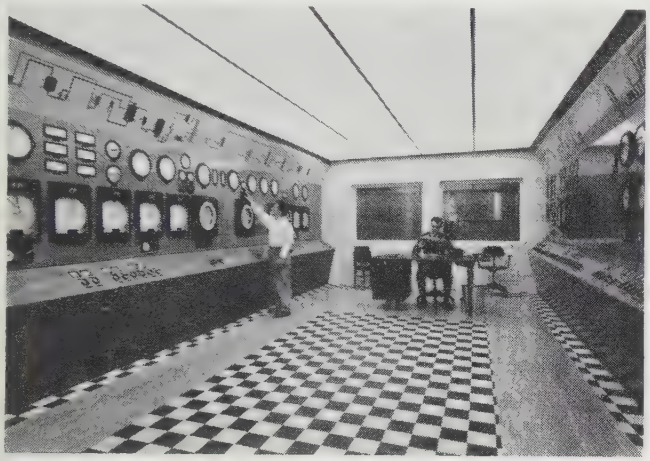

Fig. 2. Mo och Domsjö—Domsjö mill, Stora recovery process. View showing main control room

From left to right: sodium liquor line, including dissolving tank, etc., Claus system, SO_2 gas system. Note view of Claus reactor room at rear of control room.

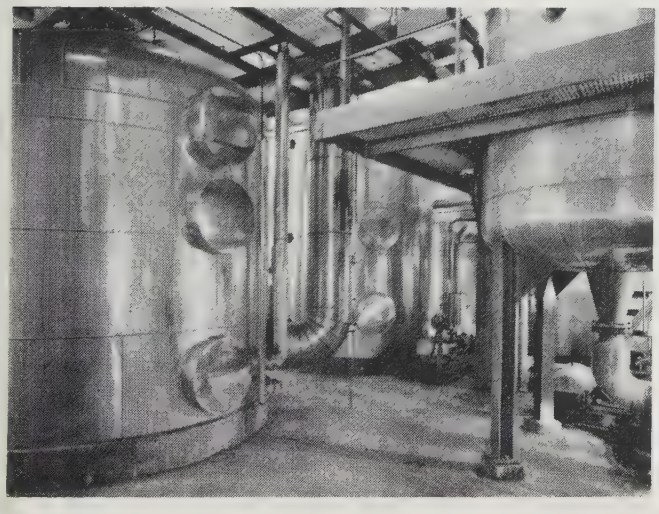

Fig. 3. Mo och Domsjö—Domsjö mill; interior of Claus department showing, from left, Claus reactor, sulfur scrubber and reaction tower

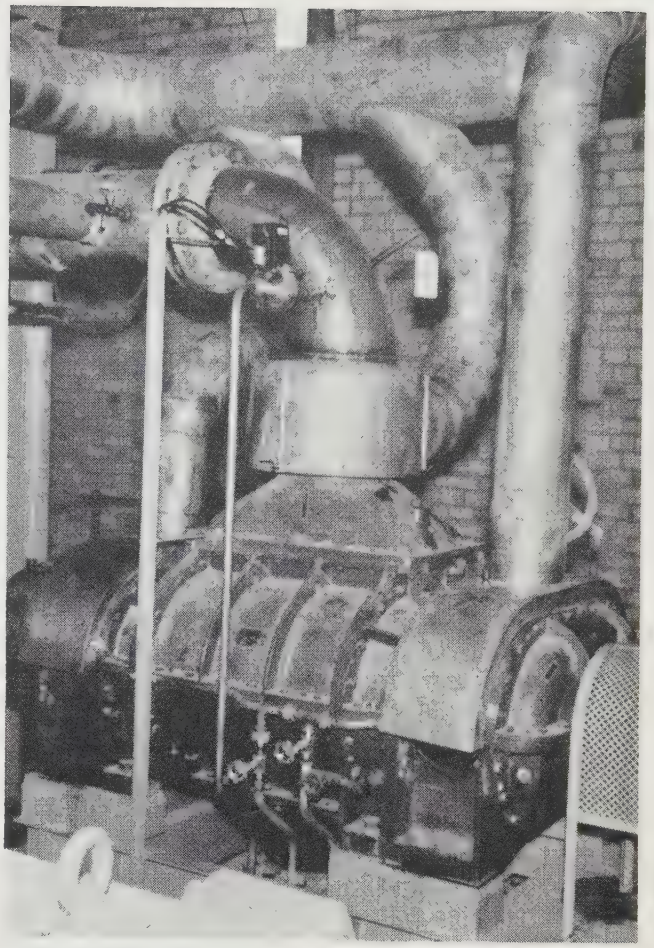

Fig. 4. Mo och Domsjö—Domsjö mill; a closeup of one of the CO_2-H_2S Roots-Connersville type compressors

Note venting system on bearings, etc., to cope with potential H_2S leaks.

type; liquor going countercurrent to steam and in parallel in two triple-effect stations, and resulting liquor through the third station, which has forced circulation on the thick liquor steps. Steam is fed to the three stations at 105 p.s.i. and leaves at 15 p.s.i. and is subsequently used to operate the distillation columns in the alcohol plant, the first part of the cooking and some other low temperature steam uses. Some scaling occurs in the last station but can be tolerated as we use station switching.

The 57% liquor is burned in a B&W 330-ton-per-day soda boiler. The electric precipitator is placed between superheater and economizer and is working at a temperature of around 350°C. The precipitator works very well after we solved some problems with sulfuric acid dewing on insulator bodies. The economizer is steel-shot cleaned. The smelt is dissolved and sulfidity is 75 to 80%.

A very good feature of the Stora process is that it is an all-liquid process which makes it suitable for automation. From the picture of the control room you can also see that we have taken advantage of that in our installation. We have one man for the process from green liquor to sodium sulfite solution. A helper in the pyrite roasting department has supervision of raw acid making from the sulfite solution. We also have one boy who makes all the analyses necessary for the control of the operation.

We have been very careful about the safety conditions when it comes to hydrogen sulfide. In order to have a complete control of the situation if there should be a gas evolution through leakage or failure, we decided not to—as it was first suggested from the safety authorities—build an open structure plant, but to put the H_2S-carrying apparatus in a separate part of the building from which a controlled outlet of ventilating air could be achieved.

All apparatus in which H_2S-bearing gases go are in the higher part of the recovery building which is separately ventilated. The outgoing air from this part of the building is vented on top of the building. The hydrogen sulfide content of this air is measured continuously using a Monocolor apparatus of German origin. The blackening of a lead acetate paper is measured with a photocell. A concentration of 20 p.p.m. is regarded safe for continuous exposure and normal values observed are considerably lower. Should the concentration exceed 20 p.p.m. an acoustic signal warns the personnel. If still higher concentration should appear, for instance, if a gas pipe should break, four fans with a total capacity of 120,000 cu. m. per hr dilute the outgoing air so that concentrations of H_2S will be within safe limits. So far, however, the gas system has been absolutely tight, and no uncontrolled H_2S has appeared. The small amounts of H_2S observed on the instrument are coming from scrubber waters from water coolers before the compressors.

Regarding the odor we have had no problems. In the flue-gas flume, some kilometers away, no smell at all can be detected.

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DISCUSSION

Chairman McCarthy: Thank you very much, Mr. Scholander. Now I think it is appropriate for anyone who has questions to be addressed to either of these gentlemen to please proceed with your questions. Are there more remarks or questions with regard to the Stora process? Thank you Drs. Cederquist and Scholander.

Before bringing this symposium to a close, I wish to call on several gentlemen who have consented to make brief comments on the overall position of the field, and also, if they desire to, with regard to these particular papers. I think it will be of interest to hear what these gentlemen say and I am sure their remarks will be short, and yet pertinent to the topical material.

We are very fortunate that Don Jackson from the Hammermill Paper Co. of Erie, Pa., is here and he has consented to speak briefly on the status of wet combustion. You may remember the Zimmerman process was operated at Hammermill for a while and I am sure we shall all be interested in hearing what Dr. Jackson will say.

Donald T. Jackson (Hammermill Paper Co.): Thank you Dr. McCarthy! Before I start, I would like to extend my thanks to Dr. Cederquist and the other gentlemen from Sweden for their very excellent paper on the Stora process, which I believe is the first report given in this country covering the details of the system. I was certainly interested to hear what Dr. Cederquist had to tell us.

As to my remarks on the Zimmerman process, when Dr. McCarthy asked me to talk for a few minutes, I hesitated for two reasons: One, there are people here in the audience who know considerably more about the process than I do. Among others Dr. Cederquist has had a great deal of experience with the method.

The second reason is, I think, we have heard just about all there is to say about the wet-combustion process as developed in this country by Zimmerman and controlled by the Sterling Drug Co. (A supplementary paper on this process follows this discussion.)

I think you all know we operated a fairly good sized pilot plant in Erie for several years. It was the first semicommercial, or larger-than-laboratory size that had been built.

We were very much interested in studying the chemistry of the wet-combustion process, and particularly to see if it would work on the recovered liquor from the semichemical pulping operation. The wet oxidation worked very beautifully on the semichemical liquor and we were well satisfied with that phase of the operation.

The other two parts, needed for an economical commercial plant, the chemical recovery from the oxidized liquor and the power recovery, or energy recovery, from the heat generated in the reaction, was not gone into extensively by us in Erie. The plant was too small to justify the installation of power recovery.

However, as you know, since that time there has been installed a rather large plant operating on calcium-base sulfite at the Borregaard mill in Norway. They were handicapped by a very abnormal low water situation this year, which delayed them in running their plant. I believe they expect to get it going by early spring of this year. Perhaps some of our visitors from abroad are more familiar with it than I am and can tell us something about it. Further development in this country, of course, has been somewhat diverted owing to Mr. Zimmerman's preoccupation with the sewerage oxidation work.

However, he is getting interested in it again and we hope that he will see fit, or the Sterling people will see fit, to further study the economic rather than technical aspects, which I am quite well convinced have been adequately explored. The economic aspects of the entire recovery of energy and of chemical recovery must be determined. Our own interest is primarily neutral sulfite, but others are interested in the technical and economic aspects of other chemical pulping processes.

There are no commercial units using the wet oxidation process operating in this country as yet. The sewage plant in Chicago is behind schedule, I understand, it will be early next year before it will be ready for trial.

The Sterling Drug Co. must realize that no pulp mill is in a position to risk the very large investment required for a full-scale commercial plant until the question of the economics of the operation has been answered. I think that covers all that I have to say on the subject.

Chairman McCarthy: Thank you very much, Don. We really appreciate your remarks. In the audience is Richter Salvesen of the Marathon Co. His company, over a very considerable period, has maintained and supported with a very large number of dollars the viewpoint that the organic substances associated with spent sulfite liquors can be made to yield many products which can be commercially sold with profit. Dr. Salvesen would you be able to make some remarks about this?

Richter Salvesen (Marathon): When your chairman, during the intermission, asked me to contribute to today's session with my comments on spent cooking liquor recovery, he also warned me that I had but three minutes for such comments. I have therefore not much time to present viewpoints which are principally different than those that have been given during the entire session today. I need hardly remind you of the present high and steadily increasing cost for pulpwood, and the rather appalling fact that presently most of the pulp mills are literally burning up or throwing away wood components amounting to around half of the pulpwood the mills are processing. Is there any industry the size of ours which makes such inefficient use of its raw material? This situation is still the same even when one of the many interesting recovery processes we have heard about today is being used.

These processes have for primary purpose to recover the cooking chemicals for re-use, and the dissolved wood components thereby disposed of through combustion, producing calories which may be more expensive than those from conventional fuel such as coal, oil, and gas. Admittedly, it is a difficult task, long strived for with considerable effort, to economically convert the dissolved wood components into marketable products to augment the return from the pulp production.

Pessimists are also pointing out the formidable problem in establishing sufficiently large markets for the enormous quantities of the presently wasted wood chemicals. But these are problems which all new and progressive industries are facing and solving—through modern teamwork between research, engineering, and marketing—with optimistic and understanding support from management.

To proponents of this long range viewpoint for our industry, the recovery processes discussed here today will at best constitute intermediate steps.

Chairman McCarthy: Thank you very much. We have heard from Drs. Cederquist and Scholander of Sweden. Now from Norway we have present Professor Hans W. Giertz, Tröndheim. I have asked this distinguished gentleman to make some comments and he has consented to do so. Therefore may I present next, Professor Giertz.

Professor Hans W. Giertz: Thank you. I have been asked by our chairman to give my remarks and I think it is my task to give more information on what is going on in the Scandinavian countries on these themes.

Not so much on recovery. Our interest in soluble bases just now is more due to pulp yield and pulp quality. You may ask if we are most interested in sodium or magnesium, and I cannot give the answer. We are just now collecting facts to see what may be the best in the future.

I think there is a general consideration that sodium is the best base from a cooking point of view. It never goes wrong with sodium. You can make the cook faster. The diffusion goes better with sodium than magnesium or calcium. Furthermore, you can work over a longer pH range. Pine is more easily cooked with sodium than magnesium. I want primarily to give some points on magnesium-base cooking but before doing that, I will say a little more about sodium and two-stage cooking.

There are two, two-stage processes used today in Scandinavia: one, the Stora process as we have heard today from Dr. Cederquist, the other is called the Kramfors process. According to this process the first step is performed at a pH of about 8 or 9. After this preliminary sulfonation, the sodium-base liquor is drained off and then the final hydrolysis goes on with ordinary calcium sulfite liquor and this can be very low in base because the base has already to some extent been introduced with the sodium in the first stage.

This process was primarily developed for cooking pine and tannin-damaged wood which cannot be cooked with ordinary calcium liquors: but as it has been shown to give very high yield it is also used for ordinary sprucewood.

As a matter of fact, the yield for unbleached pulp is 58%, and at the same time the permanganate number is low. This combination might not be possible to achieve with other processes. It is also a very strong pulp.

What about magnesium cooking? There is interest in it particularly because it makes it possible to go over to bisulfite cooking. By that I mean cooking at a starting pH of 4, and going down to pH 3; at the end of the cook that is, Magnefite or Arbiso.

This magnesium-base cooking is of special interest in Sweden. As a matter of fact, there is one new mill to be constructed in the near future and it is said to be based on acid magnesium sulfite cooking, but it can, of course, be easily changed over to bisulfite cooking. That is in the southern part of Sweden. Furthermore, the ammonium-base mill in Toten, the oldest in the world, is now converting to acid magnesium. Bisulfite cooking is also starting. There have been a lot of trials made in different mills and a long trial run is just now going on at Hunsfoss, Norway.

First of all, the quality of bisulfite pulp is quite good. As you very well know, it is possible to get a washable pulp with a yield of 60 or 62%. The pulp is stronger than ordinary, especially in bursting and tensile strength. It runs very free on the machines so it is possible to speed up the machines. The tear is also better but it is not on the same level as for sulfates. Furthermore, the unbleached MG-paper is very high in gloss.

To my mind, the bisulfite magnesium cooking is of greatest interest for unbleached pulp because then you can make use of the high yield, which really is something to shoot for. When bleached, the yield drops down to about 50% on spruce and then the gain is not the same. But, anyhow, the quality of the bleached bisulfite pulp is definitely better than for acid sulfite and, therefore, there might also be interest in the bleached pulps. So the quality of this magnesium bisulfite cooking is quite good and the higher yield makes it very interesting.

There is another thing which makes magnesium of special interest in Sweden. As you know, we have quite a lot of evaporation plants for burning calcium sulfite liquor. This is today a well-established technique. I think there are about 20 mills that already have their stainless steel evaporators. They have burning equipment, which is very simple. In general, the old boiler is used and the simple Loddby furnace is put ahead of it, which is a small cylindrical unit where the liquor is sprayed in and burned at very high temperature. The gases then pass into an ordinary boiler furnace. It seems this type of burning also can be used on magnesium liquors getting high quality magnesium oxide without carbon in it.

Therefore, we already have the equipment that is the evaporation plants and burning system to convert to magnesium and recovery. The only new section needed is the liquor preparation plant. From what we have seen from Mr. Darmstadt's paper this morning, it seems to be very easy to make a liquor from the SO_2 in the boiler gases and automatically to get a bisulfite solution liquor. Magnesium base might then be something to use for five or ten years, but then to my mind, it probably will be time to convert to the more useful sodium base. Thank you.

Chairman McCarthy: Many thanks to you, Professor Giertz. And now Dr. Walter F. Holzer, manager technical projects of the Crown Zellerbach Corp. will favor us with a few words.

Walter F. Holzer (Crown Zellerbach Corp.): Mr. chairman, gentlemen, I think we have heard some very significant papers today, and the authors and their colleagues are certainly to be congratulated on these developments. The need to use hardwoods, starting a number of years ago, brought the neutral sulfite process to life. Now these successful applications of recovery systems are bringing the process another step forward, and making it come of age.

More important, though, these recovery processes now make available to the entire sulfite industry the flexibility of the soluble base. We would see some very marked changes in this old industry in the next few years. We at Crown Zellerbach also are working on the utilization of the other half of the log, for values greater than for fuel, but I think I would take a little more moderate view than Dr. Salvesen expressed.

It is really a monumental problem suddenly to develop uses for the amount of liquors that we have in the entire industry. We are fast approaching a time when, for various reasons, we won't be able to dump them. Recovery systems, which do recover the values of chemicals and fuel in these liquors certainly are needed in this interim period until higher grade uses can be developed. As I said I think this has been a most significant session today.

CHAIRMAN MCCARTHY: Thank you, Dr. Holzer. Next we shall have the pleasure of hearing from Vance Edwardes. He has had very long acquaintance and experience in this industry. As many of you know, a few years ago he wrote a report summarizing the status of sulfite pulping recovery systems. How are things since that time, Vance?

VANCE P. EDWARDES (Diamond Alkali Co.): They are still talking about it. Most of these people have said everything I wanted to say. I too think this has been the most interesting session that I have ever attended, and out of all of this discussion and development, there is bound to come something which is going to revitalize the sulfite industry. I sometimes wonder how we ever had nerve to make pulp before we knew some of these things!

I think the committee is to be very highly congratulated on assembling a group of papers of this caliber. They really have been topnotch.

CHAIRMAN MCCARTHY: Thank you very much. May I say then for Mr. Frost, his associates on the Sulfite Pulping Committee, and for the other members who have participated in developing the program, and for myself, very many thanks to each of the participants in our symposium.

I think the presentations here today have really been marvelously interesting and revealing and it is a very great pleasure to have been able to hear what the authors have said.

Will you in the audience now join me in extending our thanks to the authors? We hope each of you in the audience has enjoyed the sessions. Thank you.

The Zimmermann Process and Its Applications in the Pulp and Paper Industry

F. J. ZIMMERMANN and D. G. DIDDAMS

Wet air oxidation of waste liquors from pulping mills has been carried out in stainless steel reactors at temperatures in the range of 200 to 300°C. and 800 to 3000 p.s.i. The oxidation of combustibles has been as high as 95% complete. At the same time, the energy from the oxidation has been converted to motivating power and chemicals have been recovered for recycling to the pulping process.

THE DISPOSAL of wastes is an urgent problem in some industries. In others the production of power and steam or the recovery of chemicals can be a significant asset. The discussion which follows presents the Zimmermann process as it applies to these ends in the pulp and paper industry. The presentation will take the following course: explanation of the fundamentals of wet air oxidation, the utilization of energy from wet air oxidation, summary of oxidation data on pulping wastes, and application of the process to specific paper mill wastes (7).

FUNDAMENTALS OF WET AIR OXIDATION

The wet air oxidation process is a continuous operation under pressure, which oxidizes combustible matter with air while both are dissolved or suspended in water. The combustion is achieved as well in water at elevated temperature and pressure as by evaporating the water and incinerating the dried residue. The products in either case are steam, nitrogen, carbon dioxide, and ash.

An example of the flow of materials is given in Fig. 1, in which air and waste liquor are proportioned into the system by their respective pumps. The liquor is preheated to a temperature at which a reasonably fast oxidation starts, for example 150 to 200°C. The air, mixed with liquor, enters a reactor of sufficient holding capacity to oxidize the fuel in the liquor. The contents of the reactor move forward continuously through a steam separator, the gases being vented while the water phase containing the ash may be used to preheat the incoming liquor.

F. J. ZIMMERMANN, President, Salvo Chemical Corp., a subsidiary of Sterling Drug, Inc.; D. G. DIDDAMS, Director of Analytical Laboratory, Salvo Chemical Corp., Rothschild, Wis.

In designing a wet air oxidation process unit, some of the factors involved are the capacity of the liquid pumps, the size of the reactor, the volume and pressure the air compressor should provide, and the heating surface required of the heat exchanger. The size of the liquid pumps is fixed by the number of gallons per minute of waste liquor to be oxidized. The sizes of the air compressors, heat exchangers, and reactor, however, are dependent upon several things, some of which are:

1. The number of gallons per minute to be handled.
2. The temperature at which the equipment is to operate. Whether a temperature of 200 or 300°C. is selected, depends on the nature of the combustibles to be oxidized. The size of the reactor is dependent on the time required to accomplish the desired extent of oxidation at a given temperature. Time-temperature-extent of oxidation relationships must, therefore, be experimentally established for each waste material. Generally the higher the temperature, and hence the pressure, the smaller the reactor will need to be to oxidize a given volume of a specific waste in a given unit of time.
3. The chemical oxygen demand or C.O.D. of the waste entering the reactor and the percentage of C.O.D. that is to be oxidized.

The object is to get the right proportion of air with the fuel, intimately mixed and under the required pressure, into a reactor so that combustion will be

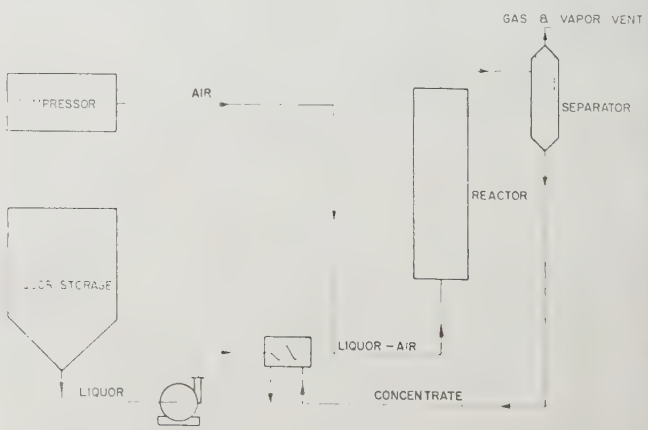


Fig. 1. Oxidation unit—energy not recovered

Table I. Heat Delivered per Pound of Air Consumed in Oxidation of Typical Materials

Material	*B.t.u./lb.*	*Pounds of O_2 per lb. material*	*Pounds of air per lb. material*	*B.t.u./ lb. air*
Hydrogen	61,000	7.937	34.34	1780
Ethylene	21,460	3.42	14.8	1450
Carbon	14,093	2.66	11.53	1220
Acetic acid	6,270	1.07	4.6	1365
Oxalic acid	1,203	0.178	0.77	1565
Pyridine	14,950	2.53	10.9	1370
Fuel oil	19,376	3.26	14.0	1380
Lactose	7,100	1.13	4.87	1455
Casein	10,550	1.75	7.55	1395
	Waste Materials			
Spent sulfite liquor solids	7,900	1.32	5.70	1385
Semichemical solids	5,812	0.955	4.13	1410
Sewage sludge primary	7,820	1.334	5.75	1365
Sewage sludge activated	6,540	1.191	5.14	1270

brought about at a speed and temperature which will either produce the most heat or eliminate the largest amount of organic waste, or both, as may be desired, and at the same time provide a liquid phase so that the oxidation is maintained.

The following principles pertain to this problem. (In a conventional system fuel is costly and air is free. In this system fuel is free and the air, which has to be supplied to the reactor under pressure, is the costly item. Consequently, in wet air oxidation, it is convenient and practical to express heat units in terms of a pound of air rather than a pound of fuel. The heat value of one pound of air has been found to be about 1350 to 1400 B.t.u., especially when applied to the several types of paper mill wastes.)

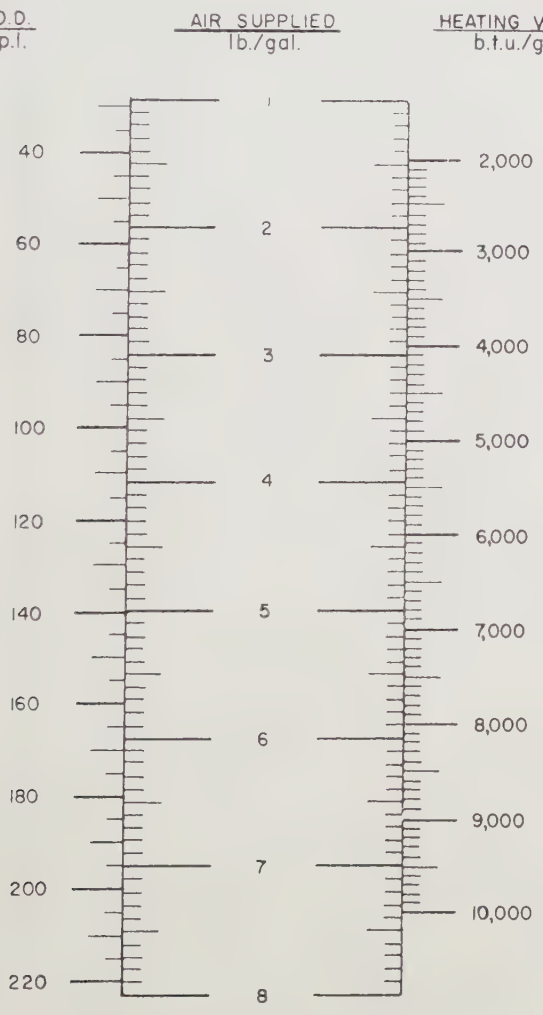


Fig. 2. Conversion chart

The conventional way of designating the relationship of fuel to the heat it produces is shown in Table I. On the right of the chart is the heat developed by one pound of air in the oxidation of the respective materials. For practically all fuels it will be seen that the heat liberated by one pound of air is about 1400 B.t.u. The pure chemicals and elements that vary in the conventional method of presentation from 61,100 B.t.u. for hydrogen to 1200 B.t.u. for oxalic acid come remarkably close together when taken as a function of one pound of air.

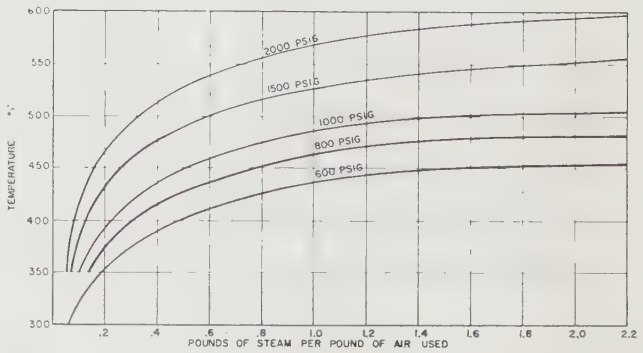


Fig. 3. Pounds of steam per pound of dry air at saturation

Figure 2 is a conversion chart which translates grams per liter of oxygen demand to pounds of air per gallon and to B.t.u. per gallon. For example, a normal calcium-base waste sulfite liquor contains 140 g.p.l. dichromate C.O.D. and 5 lb. of air per gallon of waste sulfite liquor are required to oxidize all the fuel completely. This oxidation would generate about 6800 B.t.u. per gallon.

These tools provide a means for evaluating a liquor for which the dichromate C.O.D. is known, and are presented as such. It should be emphasized that in actual practice the dichromate chemical oxygen demand is verified by complete oxidation techniques devised in the laboratories of Sterling Drug Inc. and is then related to the B.t.u. value of the specific liquor for which a reactor is being designed.

When the amount of air required for the desired extent of oxidation has been determined, the pressure-temperature relationships within the reactor are controlled to maintain a liquid phase. From Fig. 3 the exact quantity of liquid water remaining in the reactor can be calculated.

For example, a gallon of calcium-base spent sulfite liquor contains 8 lb. of water and is heated to 553°F. at 1500 p.s.i.g. with 1 lb. of air. In this case the liquid phase contains 6 lb. of water and the vapor phase 2 lb. If 4 lb. of air are forced into the reactor, all the water will be in the vapor phase and the oxidation will stop. About 3 to $3^1/_2$ lb. of air is the maximum that can be used for smooth continuous operation under the above temperature-pressure conditions. Any temperature up to the critical temperature of water can be used, however, by increasing the pressure (*3*, *6*).

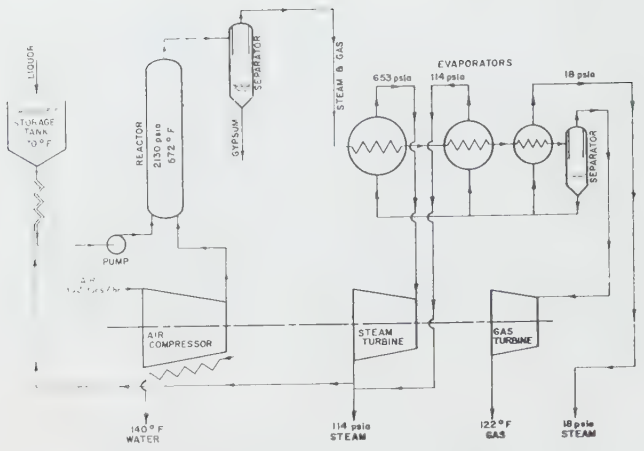


Fig. 4. Wet combustion for steam production

THE UTILIZATION OF ENERGY FROM WET AIR OXIDATION

In the foregoing section, the utilization of the energy liberated was ignored in order to confine the discussion to the principles of wet air oxidation which are employed for waste disposal. In wet combustion the reaction occurs, and the energy is liberated, in the water phase with no barrier to the transfer. Steam is thereby produced with the highest degree of efficiency. The energy contained in the oxidation effluent vapor, gases, and liquid phase can be utilized in any number of ways. Figures 4 and 5 represent two means of utilizing this energy as steam and electricity, respectively. These illustrations are presented as examples only. Many variations are possible.

SUMMARY OF OXIDATION DATA ON PULPING WASTES

Time, temperature, and oxidation studies have been made on waste liquors from both domestic and foreign paper mills. The data which are presented were obtained in either a laboratory shaking autoclave or a laboratory continuous reactor o the general type shown in Fig. 1. These laboratory studies are the starting point for the design of pilot plant and large-scale equipment. The dichromate oxygen demand is first determined on the waste liquor. The analytical value obtained is then verified by complete oxidation in the autoclave and the B.t.u. value determined by standard methods. The relationship of C.O.D. to B.t.u. is thereby established and the pilot plant unit can be

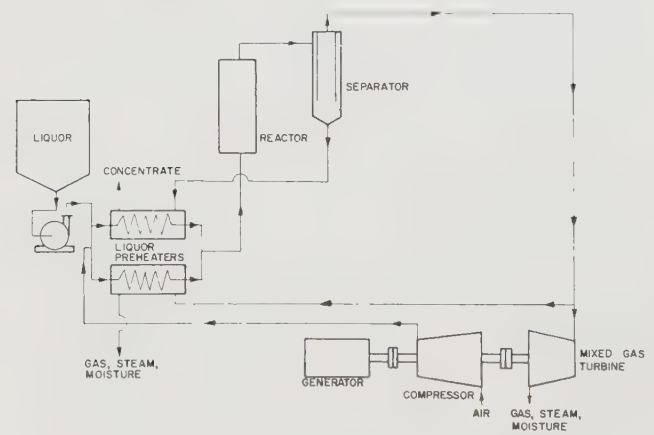


Fig. 5. Wet combustion for production of electricity

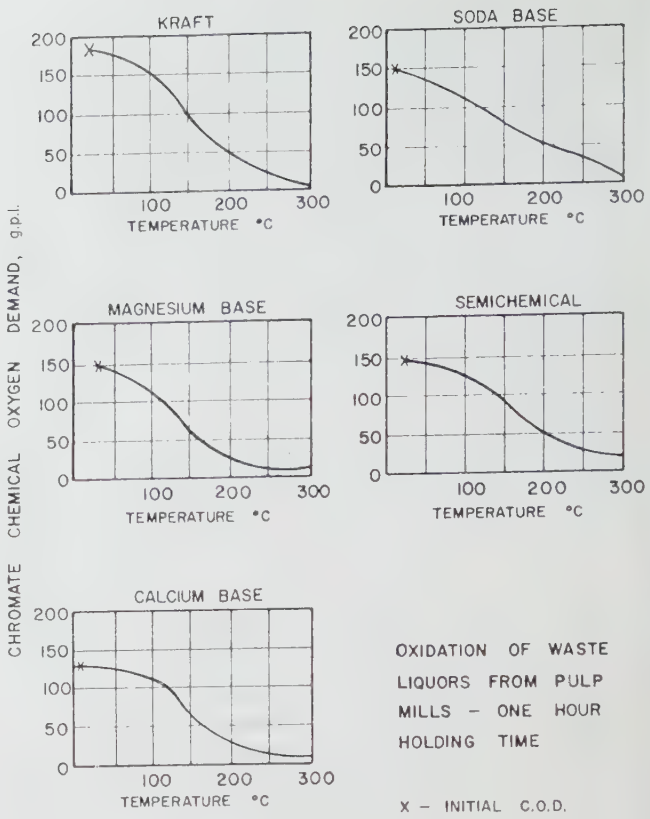


Fig. 6

designed according to the principles illustrated in the foregoing section of this discussion.

Figure 6 shows oxidation-temperature curves for representative spent sulfite liquors, while Fig. 7 shows several oxidation-time curves at constant temperature. In the latter figure, the time required to attain the temperature indicated is ignored. The data presented demonstrate that temperature is the key to the extent of oxidation and that the constituents affected at a given temperature oxidize quickly and readily, especially above 200°C. These facts have important implications in the construction of continuous oxidation devices and the adaptation of the process to any degree of oxidation desired. They also mean that stream pollution can be reduced to any point consistent with the data, or well over 90%.

During the oxidation, the organic constituents are converted mainly to carbon dioxide and water and the inorganic material is converted to either sodium, magnesium, ammonium, or calcium sulfate corresponding to the spent pulping liquor processed. If the cation equivalent is in excess of the sulfur, the corresponding carbonates are formed in addition. Conversely, if the sulfur is in excess of the cation equivalent required for the formation of the normal sulfate, the desired cation is added to the waste liquor in the oxide, hydroxide, or carbonate form in quantity sufficient to prevent the production of free sulfuric acid during oxidation. Acetic acid, an intermediate oxidation product, varies in concentration inversely with the oxidation temperature, only traces remaining at temperatures above 320°C. The inorganic materials, suspended or dissolved, exit from a continuous oxidizer in the liquid phase.

In large-scale reactors, the extent of oxidation is consistent with the laboratory results presented; and

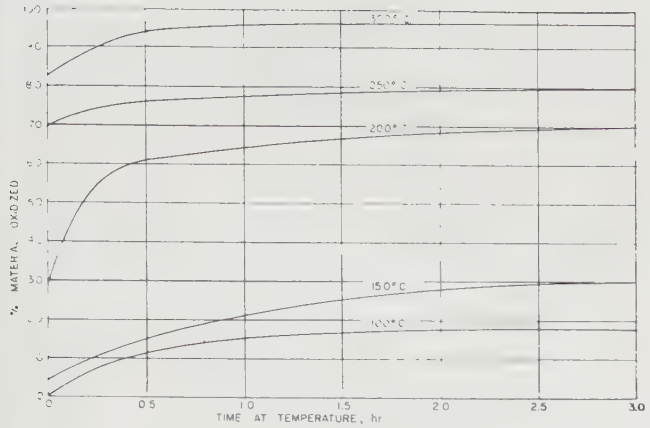


Fig. 7. Per cent oxidation versus time

about 90% of the sulfur is converted to sulfate in the 250°C. range, the conversion approaching 100% at slightly higher temperatures.

The following waste liquors from paper mills have been processed for oxidation or chemical recovery or both.

1. Magnesium-base spent sulfite liquor.
2. Semichemical acid, neutral and alkaline sodium sulfite spent liquor.
3. Calcium-base spent sulfite liquor.
4. Ammonium-base spent sulfite liquor.
5. Sodium-base spent liquor.
6. Kraft liquor.

Oxidation proceeds smoothly on all liquors processed, in general accord with the laboratory results expressed in Figs. 6 and 7. The chemical recovery is a separate problem requiring a specific treatment in each case. Examples of recovery systems are presented below one for semichemical, one for kraft, and one for calcium-base spent sulfite liquor.

APPLICATION OF THE PROCESS TO SPECIFIC WASTES

Flow Diagram and Cost Analysis for Sodium Sulfite Semichemical Liquor

Investigations on the recovery of soda from semichemical liquors were started as early as 1952 in the Sterling Drug, Inc., laboratories (*1, 4, 5*). More recently the success achieved in pilot plant kilning experiments has provided a new approach. The wet air oxidation and new chemical recovery systems for both sodium and sulfur are shown in Fig. 8.

The flow diagram represents a 200-ton pulp mill in which 10% of the waste liquor is lost in blow-pit washing and 90% is sent to a wet air oxidation unit for burning and then to a recovery unit for converting to sodium sulfite through the following reactions.

$$Na_2SO_4 + BaCO_3 \rightarrow BaSO_4 + Na_2CO_3 \quad (1)$$

$$BaSO_4 + 2C \rightarrow BaS + 2CO_2 \quad (2)$$

$$BaS + CO_2 + H_2O \rightarrow BaCO_3 + H_2S \quad (3)$$

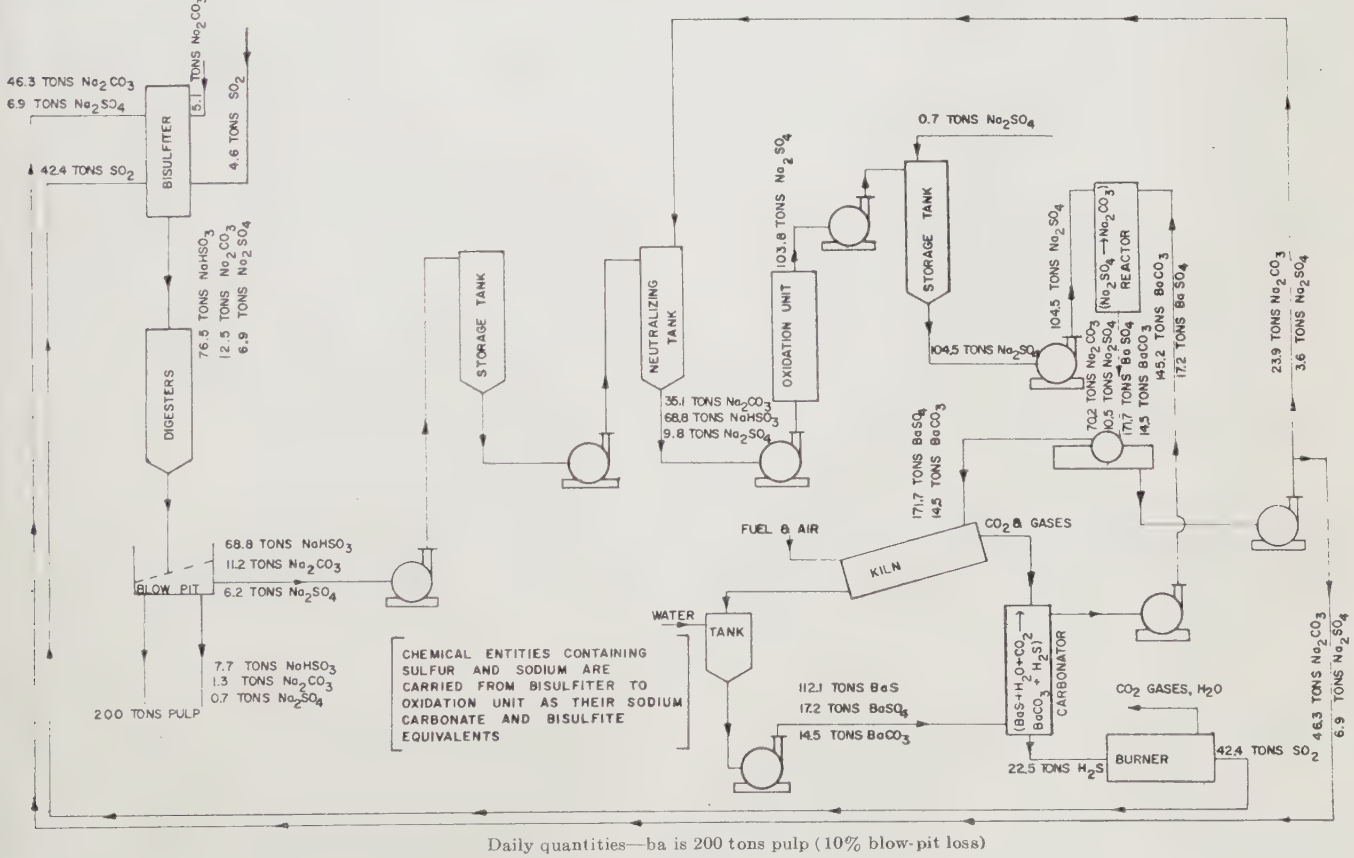
$$2H_2S + 3O_2 \rightarrow 2SO_2 + 2H_2O \quad (4)$$

or

$$2H_2S + SO_2 = 3S + 2H_2O \text{ and } 3S + 3O_2 \rightarrow 3SO_2 \quad (5)$$

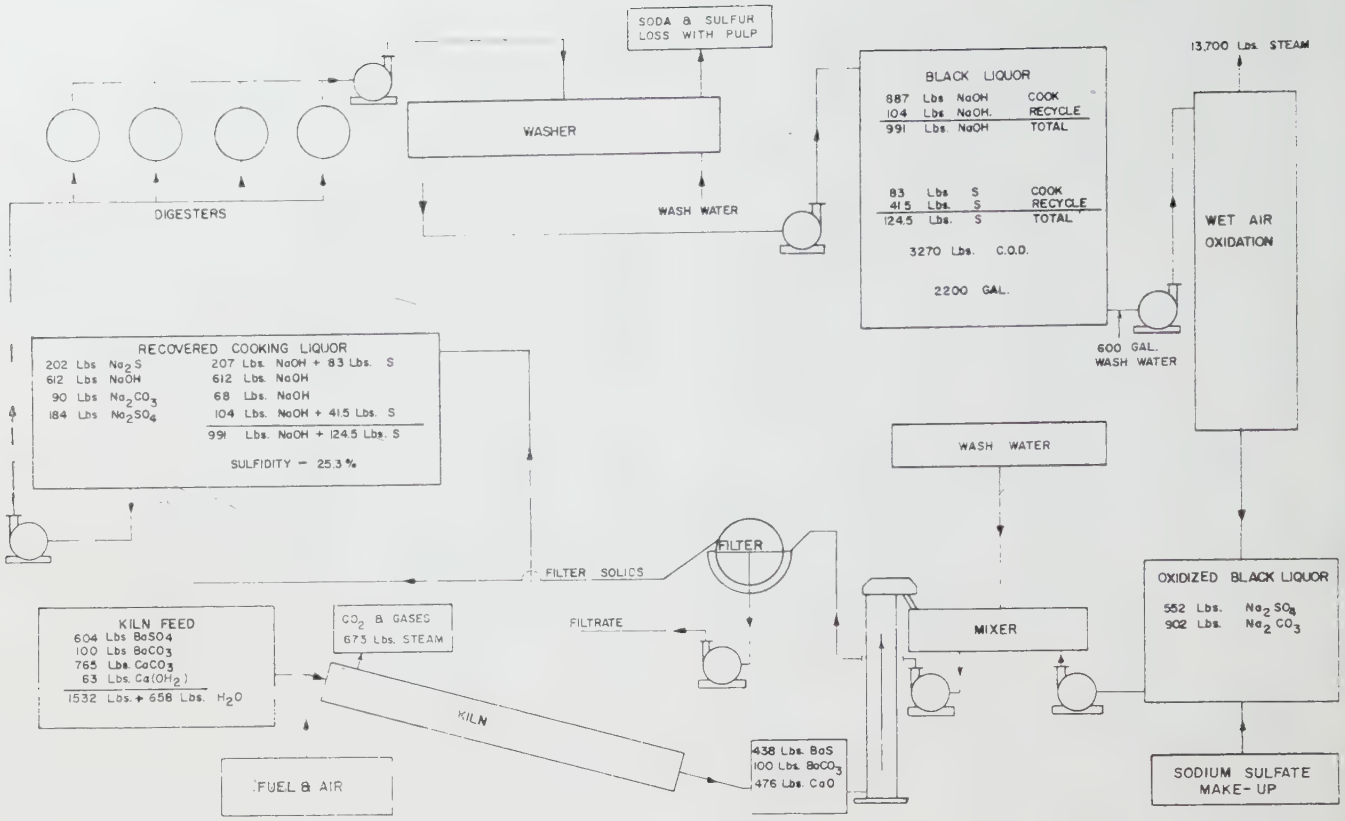
$$Na_2CO_3 + SO_2 \rightarrow Na_2SO_3 + CO_2 \quad (6)$$

Reaction 1 is about 90% complete, hence about 10% of the sodium sulfate entering the reactor for the chemical recovery cycle is shown recycling with the sodium carbonate filtrate to the bisulfiter. Pure barium carbonate is regenerated for treatment of the next cycle of oxidation unit effluent through the kiln and carbonator reactions expressed in reactions 2 and 3



Daily quantities—ba is 200 tons pulp (10% blow-pit loss)

Fig. 8. Semichemical recovery process



Calculation basis—1 ton pulp.

Fig. 9. Kraft liquor recovery process

respectively. The sulfur dioxide required for reaction 6 comes from the burner through reaction 4, to complete the recovery cycle. Extensive pilot plant runs on the reduction of barium sulfate have shown very satisfactory recovery of both barium and sulfur, while soda is quantitatively recovered in the sodium carbonate recycle to the bisulfiter.

In a large installation, the recovery of process steam or power is an additional asset. This recovery can be adapted to the specific requirements of the plant in question.

The economics of this installation are presented below in Table II, and are based on the processing through oxidation and chemical recovery of 90% of the total spent liquor from a 200-ton-per-day mill running for 350 days. The figures represent costs and returns per ton of pulp produced.

Oxidation of Kraft Liquor with Chemical Recovery and Power Cycle

The comments under the section on semichemical spent sulfite liquor apply to kraft oxidation and chemical recovery in most respects. The differences which pertain to kraft liquor are mainly in the chemical recovery unit and are shown in Fig. 9, in which the quantities represent chemicals used in the production of one ton of paper pulp. The following equations show the reactions involved.

$$BaSO_4 + CaCO_3 + 2C \rightarrow BaS + CaO + 3CO_2 \quad (7)$$

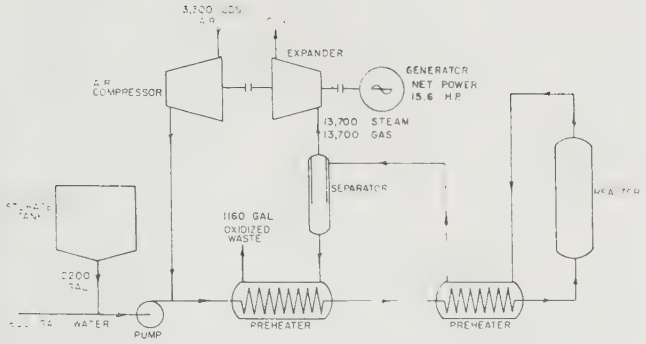
$$H_2O + BaS + CaO + Na_2SO_4 + Na_2CO_3 \rightarrow 2NaOH + Na_2S + BaSO_4 + CaCO_3 \quad (8)$$

Reaction 7 actually takes place in a reducing atmosphere and carbon monoxide is one of the products. (This reduction was carried out on a pilot-plant scale using carbon, coal, and propane successively, with equal success, at about the same temperatures used in a lime kiln.)

To complete the recovery cycle, the oxidation effluent is treated with barium sulfide and calcium oxide to produce a white liquor filtrate for the digesters and a residue of calcium carbonate and barium sulfate for the next kiln reaction as represented by reaction 8.

Table II. Cost Analysis Basis One Ton of Pulp for a 200-Ton Semichemical Plant Running 350 Days
Chemical loss at blow pit assumed to be 10%

Operating Costs			
Oxidation and Power Recovery			
a. Labor—2 men/shift @ $2.25/hr.	= $0.54		
b. Supervision	= 0.07		
c. Maintenance	= 1.50	$ 2.11	
Chemical Recovery			
a. Labor—1 man/shift @ $2.25/hr.	= $0.27		
b. Supervision	= 0.07		
c. Materials			
1. Kiln fuel (27 gal. @ $0.08)	= 2.16		
2. Sodium sulfate makeup (0.0035 ton @ $31)	= 0.11	$ 2.61	$ 4.72
Gross Returns			
Electricity (156 kw. hr. @ $0.010)	= $1.56	$ 1.56	
Chemical recovery			
a. Sodium carbonate (0.232 ton @ $35)	= 8.12		
b. Sulfur dioxide (0.212 ton @ $20)	= 4.24	$12.36	$13.92



Basis—1 ton of kraft pulp.

Fig. 10. Power recovery

The concentration and ratios of sodium and sulfur which are used in the flowsheet are those found in a specific kraft black liquor. However, all phases of the oxidation and recovery have been carried out on liquors from other sources with satisfactory yields. On the black liquor used in this example the C.O.D. value was about 178 g.p.l. and the fuel value 8500 B.t.u. per gallon. As a result, 600 gal. of water were added to the 2200 gal. of black liquor in order to reduce the fuel value to the range required for optimum conditions in the oxidizer. An additional 600 gal. of water per ton of pulp could therefore be used for pulp washing in this case.

Another advantage of this recovery system is that pure sodium carbonate and sodium sulfate are produced in the oxidizer at each cycle. As a consequence, the white liquor is not contaminated with the sodium salts of the intermediate oxidation states of sulfur.

Accompanying the chemical recovery flow sheet is a power recovery flow diagram illustrating the energy produced in the oxidizer by the waste liquor from one ton of pulp, Fig. 10.

Production of Steam from the Oxidation of Calcium Base Spent Sulfite Liquor

The oxidation of calcium-base spent sulfite liquor for the production of process steam has been carried out according to the general method represented in Fig. 4. The Borregaard Paper Co., in Norway, has installed an oxidation unit which treats the spent sulfite liquor from a 500 ton per day pulp mill. The unit should be in operation this year. In this installation, multistage axial and centrifugal compressors supply 45,000 cu. ft. of air, S.T.P. to reactors, at a pressure of 2150 p.s.i. The two reactors needed for this operation are 60 ft. high and 6 ft. in diameter. Maximum temperatures in the reaction zone are about 595°F. The reactor contents move forward to a separator where the residual water and suspended calcium sulfate exit from the bottom of the separator, and the steam and gases pass through re-boilers for the production of 20 to 120 p.s.i. process steam and about 650 p.s.i. steam for the steam turbine. The noncondensible gases are separated from the steam and pass through a gas turbine. Both turbines are mounted on the same shaft as the air compressor and provide the power required for air compression, no outside power being necessary (*2*).

SUMMARY

In the foregoing discussion, the Zimmermann process has been presented as a solution to the problem of waste disposal in paper mills. It consists of patented methods for burning combustibles in water solution at elevated temperatures and pressures.

Power and chemical recovery studies show the process to be capable of converting effluents profitably and at the same time overcoming the pollution hazards of waste disposal. The chemical recovery, steam or electrical power recovery can be designed to fit specific requirements.

LITERATURE CITED

1. Jackson, D. T. and Brown, R. W., *Pulp and Paper*, February, 1958.
2. Zimmermann, F. J., *Chem. Eng.* 65, No. 17: 117–120 (Aug. 25, 1958).
3. Zimmermann, F. J., "Wet Oxidation," one of a number of papers under the general title, "Air Utilization in the Treatment of Industrial Wastes," Engineering Institute on Industrial Wastes, 1958, University of Wisconsin Extension Division in cooperation with the College of Engineering.
4. O'Donoghue, R., *Tappi* 38, No. 6: 162A–167A (June, 1955).
5. Zimmermann, F. J., U. S. pat. 2,665,249 (Jan. 5, 1954). Schoeffel, E. W., U. S. pat. 2,750,290 (June 12, 1956). Schoeffel, E. W. and Barton, D. M., U. S. pat. 2,752,243 (June 26, 1956).
6. Sludge Treatment and Disposal by the Zimmermann Process; Twenty-Third Progress Report of Committee on Sanitary Engineering Research of the Sanitary Engineering Division, Paper 2087, *J. of San. Eng. Div., Proc. Am. Soc. Civil Engineers*, 85, No. SA-4 (July, 1959).
7. Graham, Jack B. and Burrill, Meredith, F., "Water for Industry," Publication No. 45 of the American Association for the Advancement of Science, Washington, D. C. (1956).

Received May 10, 1960.

The Compression Creep Properties of Wet Pulp Mats

HARRY D. WILDER

The creep properties of water-saturated pulp mats were determined under various constant compressive apparent stresses which were applied perpendicular to the plane of the pulp mat. The tests were carried out on mats formed from classified, unbleached, southern pine summerwood fibers. The investigation included studies of the first and second creep and creep recovery properties of such mats, as well as mat behavior under a series of creep–creep-recovery cycles and behavior in the mechanically conditioned state. It was observed that all creep and creep recovery data could be correlated using a general form of

Harry D. Wilder, Graduate Student, The Institute of Paper Chemistry, Appleton, Wis.; present address, The Institute of Paper Chemistry, Appleton, Wis.

the empirical "compressibility" equation following the first initial state of rapid compaction or recovery. This initial stage was found to be controlled by the rate of water-fiber movement, and creep appears to be of relatively little importance during this period. From these results, it is estimated that as much as a 60% increase in filtration resistance could be expected because of creep over the time range of 0.001 sec. to 10 min. When the mat has reached a state of mechanical conditioning, the increase is much less.

In the filtration and thickening processes involved in the initial formation of the paper sheet from a pulp slurry, as well as in the pressing operations which follow, the rate of water removal from the sheet is given by the general equation:

$$\text{Rate} = \frac{\text{Driving Force}}{\text{Resistance}} \qquad (1)$$

On the fourdrinier wire, this driving force is provided by the suction action at the table rolls or over the suction boxes. In the presses, the driving force is established by the mechanical compaction of the sheet in the nip of the presses. In all of these operations, the resistance to water flow is a strong function of the void fraction within the sheet. Therefore, as the sheet is compressed to lower void fractions the resistance to flow increases. Of course, increases in the stress applied to the fiber network would result in further compaction of the sheet and an increase in the resistance term. However, in addition to the stress-compaction relationship the variable of time of stress application must also be considered. If, as is the case with most polymeric materials such as cellulose, the compaction continues to increase as the time of stress application is increased, the time of stress application as well as the value of the apparent stress would be important in determining the flow-resistance term.

It is apparent from this brief discussion that a knowledge of the stress-time-deformation behavior is necessary to the complete understanding of the operations involved in sheet formation. It is also of interest to study the effect of changes in the individual fiber properties on this behavior. However, such a study was beyond the scope of this investigation.

The compressive creep test was selected for this investigation, since it allows for the separation of the variables of apparent stress, time, and deformation. This test involves the application of a constant compressive load to a preformed mat. The mat deformation is then recorded as a function of time.

THE VISCOELASTIC PROPERTIES OF FIBROUS NETWORKS IN COMPRESSION

Much has been written concerning the general behavior of materials which exhibit time-dependent as well as immediate deformations. Leaderman (*1*) gives an excellent review of the earlier work done on the creep properties of individual filaments of such viscoelastic materials; Meredith (*2*) gives a discussion of the creep test as well as other tests used in studying viscoelastic behavior. Brezinski (*3*) gives an excellent review of the subject, with special emphasis on the viscoelastic properties of paper in tension.

While the general concepts as outlined in these references are applicable to virtually all viscoelastic systems, the behavior of a relatively dry sheet of paper in tension is considerably removed from the system dealt with in this investigation. Therefore, only a brief discussion of the general subject will be given, with special emphasis on the work which has been done under compressive loadings.

When a viscoelastic material is subjected to a stress, a certain deformation is observed. This deformation depends upon the basic molecular structure of the material, as well as upon the ways in which these units are joined together in the overall system. If the stress is applied for a certain period, the deformation can be broken down into an immediate elastic deformation and a delayed deformation. If the stress is now removed, the immediate deformation is recovered unless some irreversible change has occurred in the polymer network. The recovery continues with time, but eventually a limiting value is approached. If the specimen has not been subjected to such a stress previously, the amount of deformation recovered is not as great as the amount observed during the time of stress application. Thus, a nonrecoverable deformation is observed. As the specimen is subjected to more of these creep-creep recovery cycles, the amount of nonrecoverable deformation per cycle decreases until a point is usually reached at which no more nonrecoverable deformation is observed with repeated cycling. Such a specimen is said to be mechanically conditioned.

If the wet-fiber network is considered, it will be apparent that any deformations will be due not only to deformations within the individual fibers themselves, but to slippage of entire fibers. Since the system is water-saturated, the fibers will not be held together as they would be in a "dry" sheet, so that slippage of fibers is probably of considerable importance. Also, since the fibers become more flexible when wet, they are more easily deformed. While the overall "stress" applied to the wet mat is compressive in nature, the individual fibers are subjected to bending as well as compressive stresses. Thus, certain fibers are under tension, compression, and/or bending forces. This system is much more complex than an individual fiber or filament under a tensile stress.

Unfortunately, very little is known about the behavior of fiber networks in compression and even less is known about wet systems under these conditions. Gavelin (*4*) has studied the creep behavior of newsprint, and observed a large permanent (nonrecoverable) deformation during the first creep cycle. Seborg (*5–7*) and co-workers have carried out several experiments concerning the recovery of wet pulp mats from compressive deformations and have shown these properties to be related to the flexibility of the individual fibers. This recovery from deformation increases as the sheet basis weight is decreased and as the freeness increases. The amount of recovery decreases as the duration of the compression period is increased; this shows the importance of stating the conditions under which the recoverable and nonrecoverable deformations are evaluated. Ingmanson and Whitney (*8*) have demonstrated that the mat solids concentration of a wet pulp mat is a linear function of the logarithm of the time of stress application over the time range of 20 to 1500 sec. using a compacting stress of 90.4 g. per sq. cm. Other work at The Institute of Paper Chemistry in connection with pulp drainage

studies (*9*) has shown that if an arbitrary time is allowed to elapse before measuring the mat thickness, the mat solids concentration is related to the applied apparent stress by the equation:

$$c = MP^N \qquad (2)$$

where

c = mat solids concentration,
P = applied apparent stress,
M, N = constants.

for a wide range of P values and for many types of pulp and synthetic fibers. This equation will be referred to as the "compressibility" equation. In this form, the time variable has not been considered.

EXPERIMENTAL METHODS AND APPARATUS

Pulp

The pulp used in this study was prepared from the summerwood fraction of a loblolly pine log. The separated summerwood chips were pulped by the kraft process to a permanganate number of 31.0 (using the 40 ml. permanganate test). The pulp was screened and classified in the Bauer-McNett classifier. All work was performed using the fraction retained on a 14-mesh screen. This entire procedure was designed to give maximum fiber stiffness and minimum resistance to water flow so that the water-fiber friction during the initial rapid mat deformation could be minimized.

Apparatus

A schematic diagram of the apparatus used to form and compress the wet mats is shown in Fig. 1. The deaerated, dispersed pulp is mixed in the slurry tank with water which has been heated with steam and sprayed into the tank following injection of air to strip out any air bubbles. The resulting slurry, of about 0.005% consistency, flows from the tank to the filtration tube which is baffled to provide for uniform flow. This tube is supported by a brass septum covered with a 100-mesh screen; the mat is formed on this screen by filtration from the dilute pulp slurry. The flow rate is adjusted to maintain a maximum pressure drop of one centimeter of water across the mat, since any unnecessary precompression of the mat prior to the first creep test is undesirable.

The mat-forming region of the apparatus is enclosed in a constant temperature water bath; all work was carried out at a temperature of 25.00 ± 0.05°C.

Following the completion of the formation step, a permeable piston is inserted into the filtration tube and allowed to come to rest on the mat. The piston is constructed of aluminum and is covered with a 150-mesh screen. The weight of the piston was adjusted so that it would exert a compressive force slightly greater than that resulting from a one centimeter of water pressure drop during mat formation.

Once the piston is supported by the fiber network the filtration tube is removed so that no drag forces will be encountered between the mat edges and this tube during the creep tests. The creep test is now carried out.

The stress is applied by adding weights to the piston rod while the piston is held fixed. While the major portion of this rod is also aluminum, one section is iron, and this serves as the core for the linear variable differential transformer used to measure mat deformation.

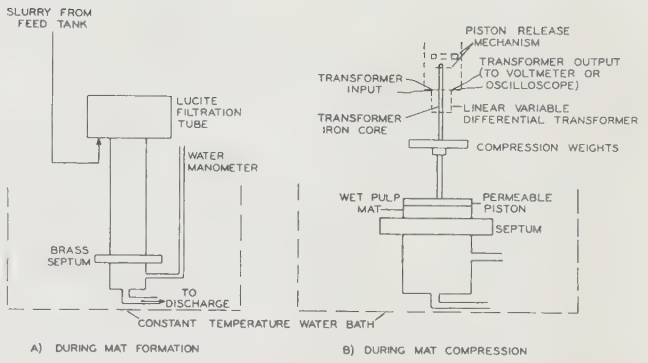


Fig. 1. Schematic diagram of creep testing apparatus

This transformer was obtained from Schaevitz Engineering, Camden, N. J., and is designed so that when a fixed voltage is applied to the input coils, the transformer output voltage is linear with core displacement. The coils of the transformer are held fixed while the core moves as the mat is compressed. For short-time measurements, the transformer output is fed to a cathode-ray oscilloscope equipped with a Polaroid Land camera attachment. The resulting trace could be directly converted to piston displacement; the horizontal displacement of the trace was proportional to the time of the test. For longer times, the transformer output was measured using a vacuum tube voltmeter. The initial mat thickness, with the unweighted piston supported by the mat, was obtained with a depth micrometer; changes from this original thickness were obtained from the transformer data. Recovery data were obtained in the same manner.

Using this technique, the results of duplicate creep runs were accurate to ±0.005 g. per cc. in terms of mat solids concentration. Within any individual run, c values could be determined to at least ±0.0002 g. per cc.; if the lowest scale on the voltmeter were used the readings were accurate to ±0.00003 g. per cc. It was felt that such accuracy was sufficient for this investigation.

Preliminary experiments indicated that the creep properties were independent of mat basis weight over the basis weight range of 0.02 to 0.08 g. per sq. cm.; all subsequent work was carried out in this range. However, the portion of the deformation-time curve observed during about the first 0.1 sec. following stress application was affected by the mat basis weight. Creep was also essentially independent of mat diameter.

RESULTS AND DISCUSSION

First and Second Creep and Creep Recovery

Creep and creep-recovery measurements were carried out over a range of apparent compressive stress of 5 to 90 g. per sq. cm. of external mat area. Each complete cycle required 5 hr., or the two-cycle run a total of 10 hr. The curves obtained using an apparent stress of 10.85 g. per sq. cm. are shown in Fig. 2; all other curves exhibited a similar form.

After an initial rapid change in mat solids concentration, both the creep and creep-recovery curves become essentially linear functions of the logarithm of time of stress application. The "compressibility" equation used to correlate mat solids concentration and apparent

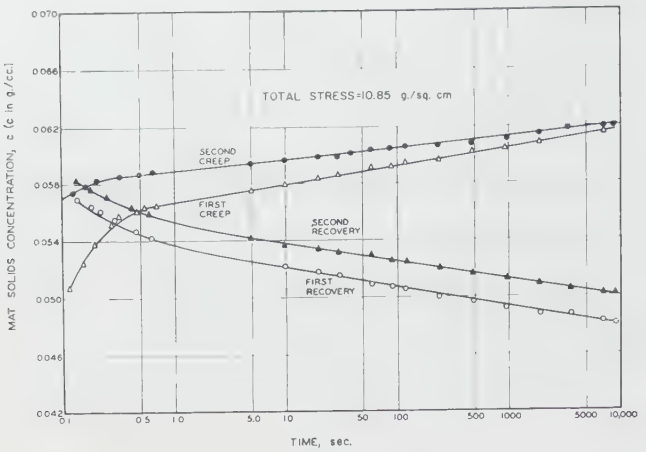


Fig. 2. First and second creep and creep-recovery data

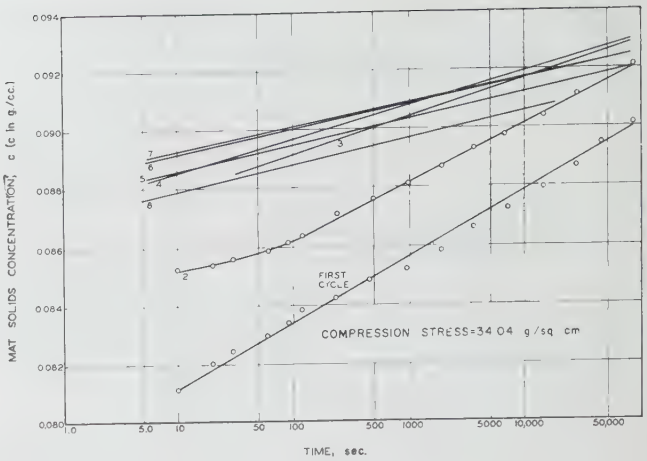


Fig. 3. Wet-mat behavior during repeated cycling (compression). (Numbers refer to cycle number)

stress can be modified so that the constant, M, now includes the time variable:

$$M = A + B \cdot \log t \qquad (3)$$

where A and B are two new constants and t represents time. If another constant, c_0, is added, equation (2) becomes:

$$c - c_0 = (A + B \cdot \log t)P^N \qquad (4)$$

Through proper evaluation of the constants, it was found that both first creep and creep recovery data could be correlated using equation (4). When dealing with first creep recovery, it was necessary to include a term to account for the nonrecoverable deformation encountered.

If equation (4) were valid down to zero applied stress, c_0 would represent the mat solids concentration under no stress. The value of c_0 obtained from the first creep data (c_0 = 0.0208 g. per cc.) is in good agreement with that estimated by Ingmanson and Whitney (*8*).

Subsequent Cycles; The Mechanically Conditioned State

Since a significant difference exists between the first and second creep behavior under equal apparent stress, it is apparent that a considerable amount of nonrecoverable deformation is introduced. Therefore, one mat was subjected to several 24 hr. creep–24 hr. creep-recovery cycles in an effort to determine how many cycles were required to produce a state of mechanical conditioning. The creep and creep-recovery values for the first eight cycles (apparent stress = 34.04 g. per sq. cm.) are shown in Figs. 3 and 4. It is apparent that at least six such cycles are required. Following this the mat has reached a state of mechanical conditioning.

Once the nonrecoverable deformations were eliminated, further creep and creep-recovery tests were made on this mat under applied apparent stresses of five to 34 g. per sq. cm. Both the creep and recovery curves over the 5-hr. cycles used could again be correlated using the general form of the compressibility equation, equation (4). The equations obtained for both first creep and creep-recovery behavior and creep and creep recovery of the mechanically conditioned mat are given in Table I.

Effect of Creep on Drainage Resistance

It has been stated that a decrease in the void volume of a sheet due to creep would increase the resistance to water flow through this sheet. In the work done at the Institute the Kozeny-Carman equation has been used to relate the specific filtration resistance, R, to the sheet characteristics (*8*). If the entire sheet is sub-

NOMENCLATURE

- A, B = constants in the generalized creep and recovery equations
- c = mat solids concentration, g. O.D. fiber per cc. of mat volume
- c_0 = constant in generalized creep and creep recovery equations
- F_1 = force due to frictional drag forces between fiber and water, dynes
- F_2 = force due to mechanical strength of the fiber network, dynes
- g = gravitational constant, 980 cm. per sec.^{2}
- k = Kozeny "constant" in filtration equation
- K = calculated quantity in short-time behavior study, $[kS_w^2(W/A)\mu]/v$
- m = mass of the compression piston plus attached weights, g.
- M = constant in "compressibility" equation
- N = constant in the "compressibility" and creep equations
- P = applied apparent stress, g. per sq. cm.
- R = specific filtration resistance, cm. per g.
- s = distance of piston travel, cm.
- S_w = hydrodynamic specific surface, sq. cm. per g.
- t = time, sec.
- v = hydrodynamic specific volume, cc. per g.
- W/A = mat basis weight, O.D. g. per sq. cm.
- μ = fluid viscosity, poises

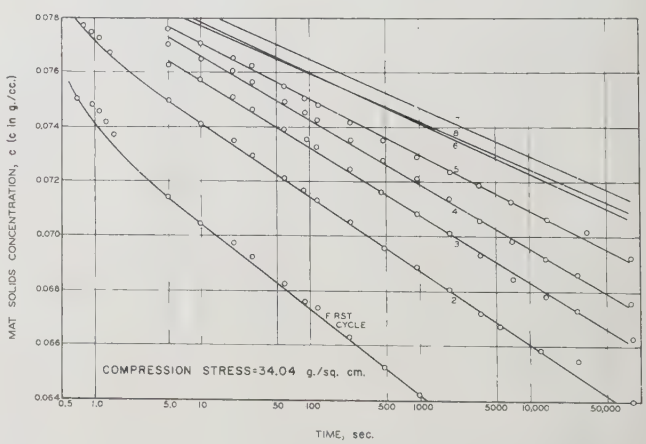


Fig. 4. Wet-mat behavior during repeated cycling (recovery). (Numbers refer to cycle number)

Table I. Summary of Creep and Creep-Recovery Equations

Type	*Equation*
First creep	$c - 0.0208 = (0.01227 + 0.000487 \log t)P^{0.403}$
First creep recovery	$c - 0.0340 = 0.00450P^{0.360} + (0.00158 - 0.000408 \log t)P^{0.486}$
Mech. cond. creep	$c - 0.06738 = (0.00387 + 0.000174 \log t)P^{0.462}$
Mech. cond. creep recovery	$c - 0.07162 = (0.000865 - 0.000215 \log t)P^{0.462}$

c = mat solids concentration, g. per cc.
t = time of apparent stress application, sec.
P = apparent stress, g. per sq. cm.

jected to a uniform compacting force, this equation may be written:

$$R = \frac{kS_w^2c}{(1 - vc)^3} \qquad (5)$$

where

R = specific filtration resistance.
k = Kozeny "constant."
c = mat solids concentration.
v = pulp hydrodynamic specific volume.

If we wish to compare the resistance values of the same pulp under two arbitrarily chosen values of c, this difference can be expressed as:

$$\left[\frac{R_1 - R_2}{R_1}\right] \times 100 = \frac{\left[\frac{c_1}{(1 - vc_1)^3}\right] - \left[\frac{c_2}{(1 - vc_2)^3}\right]}{\left[\frac{c_1}{(1 - vc_1)^3}\right]} \qquad (6)$$

In this study, it was of particular interest to determine the percentage change in filtration resistance due to creep over the time range of 0.001 to 600 sec., since these times represent the approximate times of stress application over any individual table roll as compared to the time of stress application in a laboratory drainage experiment. The differences attributable to creep, assuming these relationships to apply at such short times, are shown in Table II for both first and mechanically conditioned creep under apparent stresses of 10 and 100 g. per sq. cm. (The hydrodynamic specific volume of this pulp was obtained from drainage studies and was 3.62 cc. per g.) It is seen that very significant changes can be attributed to creep effects.

Importance of Creep at Short Times

The creep curves of Fig. 2 indicate that the initial change of mat solids concentration with log (time) is much more rapid than over the final linear portion of the creep curve. However, at such short times the deformation is further complicated by the frictional drag forces set up by the water-fiber movement. If the creep during this period is of no greater importance than at later times, then this water-fiber movement would control the rate of mat deformation during this initial period. Since the rate of piston movement is known as a function of time, the following force balance can be written for this period:

Table II. Effect of Time of Stress Application on Calculated Values of Specific Filtration Resistance, *R*

Apparent stress, g./sq. cm.	*Relative change in R, %*	
	First creep	*Mech. cond. creep*
10	26	8
100	62	25

Table III. Calculated and Theoretical Values of *K* for Typical Short-Time Behavior

t, sec.	$K_{calc.} \times 10^{-3}$	$K_{theor.} \times 10^{-3}$
0.0079	9.7	12.3
0.0158	6.6	12.2
0.0236	6.5	12.0
0.0315	7.8	11.6
0.0472	11.0	11.4
0.0630	11.9	11.2
0.0787	9.6	11.0
0.0945	11.1	10.9
0.1260	14.1	10.8

$$m\left(\frac{d^2s}{dt^2}\right) = mg - F_1 - F_2 \qquad (7)$$

where

m = mass of piston plus attached weights.
s = distance.
t = time.
$\left(\frac{d^2s}{dt^2}\right)$ = piston acceleration.
g = gravitational constant.
F_1 = restraining force due to fiber network strength.
F_2 = restraining force due to water-fiber drag forces.

The restraining force, F_1, can be calculated if it is assumed that equation (2) can be used to relate the force, F_1, to the mat solids concentration, c. The frictional drag force, F_2, can be evaluated using the Kozeny-Carman equation if it is assumed that the mat solids concentration is uniform throughout the mat at any instant. Using this approach, the theoretical value of filtration resistance can be compared with the value obtained using equation (7). Table III shows the calculated and theoretical values of K for one particular run; K is related to the specific filtration resistance, R, by the equation:

$$K = R(W/A)\mu(1 - vc)^3/vc \qquad (8)$$

where

W/A = basis weight.
μ = fluid viscosity.

When these results are observed, it is found that at times greater than about 0.04 sec. good agreement is obtained between the theoretical and calculated results. At shorter times, the agreement is not as good, but the difference is opposite to that expected if creep were of importance. This variation is probably due to the assumption made concerning uniform mat solids concentration throughout the mat; at very short times the fluid drag forces result in a non-uniform concentration across the sheet.

From this work it may be concluded that the creep rate does not increase significantly at times greater than 0.04 second; there are no indications that such an increase over the linear behavior observed at longer times does occur at shorter times, although this region has not been adequately investigated.

LITERATURE CITED

1. Lee.derman, H., "Elastic and Creep Properties of Filamentous Materials and other High Polymers," Washington, D. C., The Textile Foundation, 1943, 278 p.
2. Meredith, R., ed., "The Mechanical Properties of Textile Fibers," New York, Interscience, 1956, 333 p.
3. Brezinski, J. P., "A Study of the Viscoelastic Properties of Paper by Means of Tensile Creep Tests," Doctor's Dissertation, Appleton, Wis., The Institute of Paper Chemistry, 1955, 242 p.
4. Gavelin, G., *Svensk Papperstidn.* 52, No. 17: 413–419 (1949).

5. Seborg, C. O., Simmonds, F. A., and Baird, P. K., *Paper Trade J.* 109, No. 8: 35 (1939).
6. Seborg, C. O., and Simmonds, F. A., *Paper Trade J.* 125, No. 15: 63 (1947).
7. Seborg, C. O., and Simmonds, F. A., *Paper Trade J.* 113, No. 7: 49 (1941).
8. Ingmanson, W. L., and Whitney, R. P., *Tappi* 37, No. 11: 523–533 (1954).
9. Ingmanson, W. L., and Jappe, N. A., Unpublished work, 1959.

Received Feb. 11, 1960.

A portion of a thesis submitted in partial fulfillment of the requirements of The Institute of Paper Chemistry for the degree of Doctor of Philosophy from Lawrence College, Appleton, Wis., June, 1960. This work was carried out under the direction of Sheldon Kurath.

Factors Affecting the Warping of Fiberboard Roof Insulation

J. W. GEDDES and J. J. PEROT

Fiberboard is used extensively as insulation applied over steel, poured gypsum, and other types of concrete roof decks. If the material warps or buckles, severe problems are created for the applicator of the built-up roofing used in this type of construction. Warping is directly related to the moisture content of the fiberboard insulation, its color, and to the time of exposure. Warping decreases (at the same moisture content) as thickness increases. Warping is caused by a moisture gradient between the upper and lower surfaces of the insulation. Migration of moisture from the warmer upper face to the cooler lower face plus loss of moisture to the air from the upper surface causes expansion of the lower surface, contraction of the upper surface, and results in warping. No significant differences in warping tendencies were noted among a series of commercially available products; indicating that type of fiber, pulping processes, and machine formation are not major factors in this problem. In commercial practice, difficulties can be eliminated by: (1) manufacturing the material with low moisture content, (2) observing proper shipping and storing procedures, and (3) following recommended application procedures, including prompt application of the built-up roof.

The growing awareness of the importance of effective insulation is a natural result of ever-increasing fuel costs and the constantly expanding use of air conditioning. The inexorable laws of heat flow focus attention on the ceilings and roofs. Although this article is concerned primarily with flat roofed industrial construction, the same principles apply whenever fiberboard insulation is used.

The extent to which fiberboard roof insulation is used is shown by the production reported during 1958, the most recent year for which statistics are available. During that year 431,442,000 sq. ft. (0.5-in. basis) were produced.

For those of you who may not be familiar with this particular fiberboard product, it can be described as a strong, compression-resistant material supplied in easily handled sheet form. The most common size is approximately 2 ft. wide by 4 ft. long. Thickness normally ranges from 0.5 to 3 in. in increments of 0.5 in., and depends upon the thermal resistance required for each individual application.

Fiberboard roof insulation is supplied by most manufacturers in several types: (1) natural, (2) asphalt impregnated, (3) asphalt coated natural, and (4) asphalt coated and impregnated. These four types are usually available with or without special preservative treatments to increase the resistance of the product to decay.

The physical properties of fiberboard roof insulation are defined in a number of widely circulated specifications:

1. Federal Specification LLL-F-321b Class C.
2. Interim Federal Specification LLL-F-00321b, Class C.
3. U. S. Department of Commerce Commercial Standard CS-42-49, Class C.
4. American Society of Testing Materials Standard C-208-57T, Class C.
5. Simplified Practice Recommendation R257-55 "Thermal Conductance Factors for Preformed Above-Deck Roof Insulation," U. S. Department of Commerce.

Methods of test for evaluating the properties of fiberboard roof insulation are detailed in TAPPI Standards and in the above specifications.

THE WARPING PROBLEM

Fiberboard roof insulation is usually adhered to the roof deck by hot asphalt or pitch. In cold climates a vapor barrier is recommended between the deck and the fiberboard insulation to avoid any possibility of condensation of water vapor within the fiberboard. A multilayer built-up roof is applied over the insulation by hot-mopping four or five courses of asphalt or pitch saturated felts.

The vast majority of these installations proceed without incident. The roof areas involved are enormous; one half million-square feet jobs are routine. Therefore, the rare complaint receives the full attention of the Sales and Technical Personnel of the manufacturer involved.

Observation of several such installations revealed a recurrent pattern: (1) complaints were usually reported during warm (usually hot) and sunny weather; (2) warping was not permanent, and material which was curled up at the edges one day would sometimes lie flat the next; (3) the moisture content of the complaint material was usually high (10% or more based on dry-fiber weight).

LABORATORY INVESTIGATION

Method of Test

To conduct a systematic and organized study of the factors involved in this problem, it was necessary to device a laboratory procedure which would closely

J. W. Geddes, Research Engineer, and J. J. Perot, Group Leader, National Gypsum Research Center, 1650 Military Road, Buffalo 17, N. Y.

Table I. Effect of Moisture Content on Warping of Fiberboard Roof Insulation

Type of insulation and manufacturer	*Moisture content, % by wt.*	*Warp, in., versus exposure, hr.* 1/4	1/2	3/4	1	1 1/2	2	3	4
1 in. thick asphalt coated Manufacturer "N"	1.5	0.01	0.02	0.04	0.03	0.02	0.01	...	...
	2.3	0.03	0.16	0.22	0.26	0.28	0.29	0.33	0.26
	5.5	0.16	0.40	0.56	0.70	0.77	0.79	0.76	...
	14.5	0.23	0.44	0.66	1.24	1.25	1.21	1.09	0.89
1 in. thick asphalt impregnated Manufacturer "N"	0.8	0.01	0.01	0.00	0.00	...	...	...	...
	2.4	0.03	0.05	0.08	0.09	0.14	0.17	0.20	0.17
	5.3	0.14	0.34	0.42	0.53	0.59	0.61	0.61	...
	10.2	0.36	0.59	0.78	0.89	1.00	1.06	1.02	...

simulate job conditions while at the same time permit good control over the variables under study.

To provide an "artificial sun," a rack (48 by 96 in.) was constructed on which were located four rows of infrared lamps (Westinghouse Reflector Infrared 250 w.) spaced 12 in. on centers. The assembly was so fashioned that the height of the lamps could be easily adjusted.

Measurements of roof-deck temperatures at various geographical locations were made using black-bulb thermometers. Results showed that temperatures up to 180°F. were attained and that temperatures of 140 to 160°F. were common throughout the country during the summer months. It was then arbitrarily decided to conduct tests at a black-bulb temperature of 160°F. measured at the height of the upper surface of the board under test.

The test specimens were not restrained during exposure but were simply laid on the concrete floor. In actual use application they would be adhered to the deck with asphalt or pitch. This was obviously impractical for a laboratory test. It is believed that the warpage figures reported here are probably higher than would be found in actual use.

For the purposes of this report, "warp" will be defined as the distance from the bottom surface of the roof insulation to the floor and is reported as the average of the measurements made at the four corners of a 2 ft. by 4 ft. sample.

DISCUSSION AND DATA

Three series of experiments were conducted:

1. Warping tests on replicate samples with moisture content as the variable.
2. Warping tests on a series of commercially produced 0.5-in. thick fiberboard roof insulation.
3. Warping tests on a series of commercially produced 1-in. thick samples of fiberboard roof insulation.

The results of these tests are shown in Tables I, II, and III.

Considering the data in Table I, it is readily apparent that degree of warp is a function of both moisture content and time of exposure. These relationships are shown graphically in Fig. 1. These curves clearly show the effects of time and moisture content on degree of warp and also show that, at equal moisture content, the darker colored asphalt coated material exhibited greater warp.

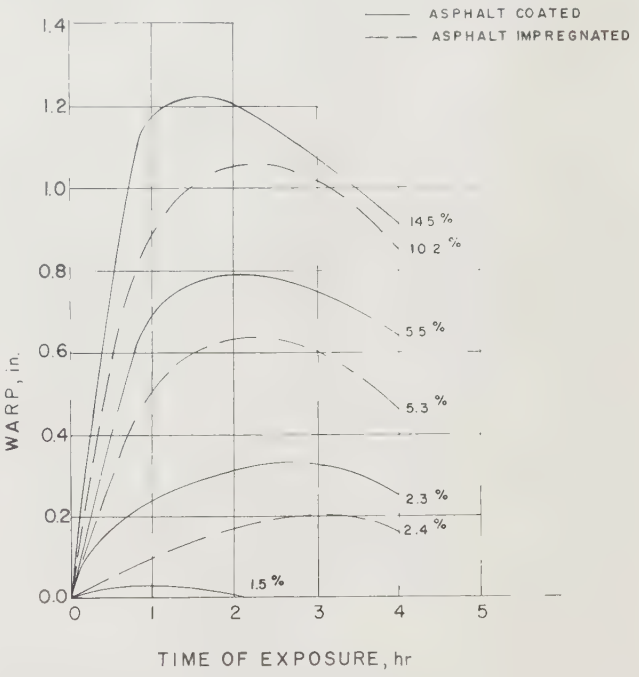


Fig. 1. Effect of moisture content on warp of 1-in. fiberboard roof insulation

Table II. Results of Warping Tests on One Half Inch Fiberboard Roof Insulation

Type of insulation and manufacturer	*Moisture content, % by wt.*	*Warp, in., versus exposure, hr.* 1/4	1/2	3/4	1	1 1/2	2	3	4
Natural Manufacturer "F"	7.9	0.62	0.73	...	0.72	0.65	0.60	...	0.27
Natural Manufacturer "J"	8.0	0.45	0.61	0.71	0.73	0.71	0.65	0.55	...
Natural Manufacturer "W"	6.4	0.42	0.58	0.64	0.64	0.67	0.62	0.62	0.59
Natural Manufacturer "K"	4.6	0.52	0.58	0.59	0.56	0.49	0.45	0.41	0.38
Natural Manufacturer "U"	7.5	0.34	0.56	0.61	0.63	0.63	0.57	...	...
Asphalt impregnated Manufacturer "J"	6.8	0.89	0.94	0.97	0.95	0.83	0.73	0.72	0.60
Asphalt impregnated Manufacturer "F"	7.2	0.82	0.93	1.01	0.97	0.94	0.93	0.80	...

Table III. Results of Warping Tests on One Inch Fiberboard Roof Insulation

Type of insulation and manufacturer	Moisture content, % by wt.	Warp, in., versus exposure, hr. 1/4	1/2	3/4	1	1 1/2	2	3	4
Natural Manufacturer "J"	7.9	0.15	0.26	0.34	0.36	0.41	0.42	0.45	0.42
Asphalt impregnated Manufacturer "A"	7.6	0.08	0.14	...	0.31	0.44	0.48	...	0.52
Asphalt impregnated Manufacturer "B"	6.3	0.28	0.47	...	0.64	0.65	0.61	...	0.51
Asphalt impregnated Manufacturer "C"	7.8	0.14	0.27	...	0.43	0.52	0.62	...	0.66
Asphalt impregnated Manufacturer "J"	7.0	0.12	0.25	0.37	0.42	0.51	0.52	0.50	...
Asphalt coated Manufacturer "F"	7.5	0.22	0.45	0.66	0.74	0.81	0.78	0.72	...
Asphalt impregnated Manufacturer "N"	5.3	0.14	0.34	0.42	0.53	0.59	0.61	0.61	...

Table II presents warp data on a series of commercially available, 0.5 in. thick fiberboard roof insulations.

Table III presents comparable data on 1-in. thick material. These figures show that:

1. The thinner, 0.5-in. material warps much more quickly than the 1-in. material.
2. The asphalt-impregnated (and therefore darker in color) 0.5- in. samples showed more warping than the lighter colored "natural" boards. All of the 1-in. samples tested were asphalt impregnated except two; one of which was "natural" and the other asphalt coated. It will be noted that the asphalt-coated sample showed the greatest warp, the "natural" sample the least, and the impregnated boards an intermediate amount (see Fig. 2).

The above observations clearly indicate the importance of the role of moisture in the warping of fiberboard roof insulation.

Work by Prof. F. A. Joy of the University of Pennsylvania (unpublished) had shown that moisture in wood fiber migrates when a temperature differential exists between the two surfaces of the fiberboard. This is one of the factors involved here in the warping of fiberboard roof insulation. The other is the actual drying, or loss of moisture vapor due to exposure to the sun or to the heat lamps in our experiments.

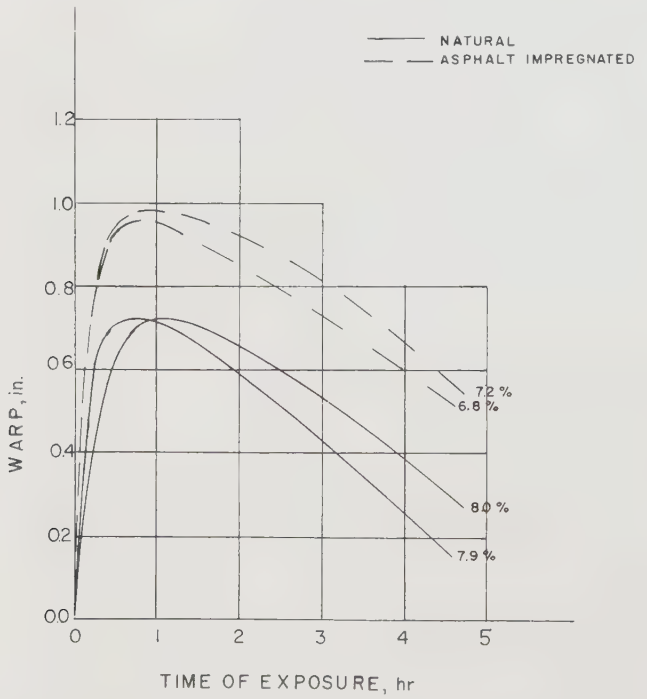


Fig. 2. Effect of color on warp of 0.5-in. fiberboard roof insulation

To demonstrate this, a sample of 1-in. asphalt-impregnated roof insulation with an average moisture content of 6% was exposed under the lamps for 2 hr. At the end of this period an average warp of 0.6 in. was observed. The sample was reweighed, and the moisture content after the test was found to be 5%.

Sections approximately 1/8-in. thick were immediately cut from the upper and lower surfaces. Moisture content determinations showed 3% for the upper layer and 7% for the bottom surface.

Obviously the observed warping is due to contraction of the upper surface upon drying coupled with the expansion of the lower surface due to the increased moisture content resulting from migration.

PREVENTIVE MEASURES

Warping can be eliminated by observing a few common sense practices. First, the material should be produced at as low a moisture content as is practical. Secondly, it must be protected from moisture during shipping, warehousing. and on-the-job storage. Finally, it is important that the fiberboard roof insulation be covered promptly by the built-up roofing.

SUMMARY

The problem of warping of fiberboard roof was observed in the field and a laboratory test procedure devised to simulate job exposure and to permit an orderly exploration of the factors deemed to be most important.

It was found that degree of warp was directly proportional to moisture content and time of exposure (within normal application procedures). Board formation, refining, and type of fiber appeared to have little effect.

The mechanism of warping was found to be a combination of moisture migration due to temperature differential between the upper and lower surfaces of the insulation and to drying out of the exposed surface. Both factors result in contraction of the exposed upper surface and expansion of the lower surface.

Preventative measures suggested are production of material at minimum practical moisture contents, dry storage prior to application, and immediate application of built up roofing together with its normal slag or gravel covering.

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Unexpected Variables Affecting the TAPPI-SFMC* Drainage Time Tester of Suggested Method T 1002 sm-51

WILLIAM G. COGGAN

Difficulties experienced in predicting the drainage characteristics of groundwood and semichemical pulps on insulating board forming machines have prompted an investigation of some variables not included in the Standard Drainage Time Test for Insulating Board Pulps (T 1002 sm-51). The variables investigated were size and alum addition and cleanliness of the pulp and water. The pulp types tested were willow and pine groundwoods, neutral sulfite and cold soda semichemicals, and Asplund-defibrated pine. The drainage times of willow groundwood and cold soda pulps, which were poorly washed, were significantly increased after alum addition. Apparently, the alum reacted with the dissolved solids carried through the process to form a gelatinous precipitate which increased the drainage time by partially blinding off the screen. Pine groundwood, neutral sulfite semichemical pulp, and Asplund-defibrated pine did not exhibit this effect. Size and alum addition had no measurable effect on the drainage time of any of the pulps, when dewatered pulp and tap water were used in the test. These data indicate that the Suggested Method of determining the standard drainage time of pulp for insulating board be expanded to include as many conditions as possible to which the pulp will be exposed in its environment on the forming machine, since its "machine drainage time" may be significantly different than indicated by the Standard test, which uses dewatered pulp and fresh tap water for dilution.

THE SUGGESTED Method T 1002 sm-51 for the standard drainage time of pulp for insulating board was developed to provide a means for determining accurately the drainage times of coarse, easily dewatered insulating board and similar pulps. This method has proved reliable (*1*, *2*, *3*) and is used widely in the insulating board industry (*3*, *4*). The effects of water, temperature (*5*, *6*, *7*), and air entrapment (*7*) in the pulp on drainage time are well known and are included in the description of the test procedure.

Recently, however, unexpected erratic results experienced in predicting the drainage characteristics of groundwood and semichemical pulps on insulating board forming machines have suggested that other variables, not included in the Standard drainage-time test but normal to the pulp in ordinary mill operation, may influence drainage time.

Accordingly, a study has been made to explore the effect of possible variables on drainage time test results.

DISCUSSION

Variables Investigated

The variables selected for study were size and alum addition and cleanliness of the water used to dilute the pulp sample for the test. Size and alum addition was selected because these additives are routinely added to the pulp in the mill but not in the Standard drainage-time test.

Cleanliness of the water used for dilution was chosen because insulating board pulps normally receive only a cursory washing and are diluted for board forming with white water while the drainage-time test specifies the use of tap water for dilution.

Pulps Tested

It was considered desirable to check the variables selected on as many pulp types as possible, since the various pulping processes differ widely from a chemical standpoint, as well as the inherent species differences and all pulps would not be expected to exhibit the same effect with any given variable. The pulp types studied were: pine groundwood, willow groundwood, neutral sulfite semichemical hardwood, cold soda hardwood, and Asplund-defibrated pine.

Methods Used to Determine Standard Drainage Time

Suggested Method T 1002 sm-51 for the Standard drainage time of pulp for insulating board calls for the test to be run using dewatered pulp and tap water at 80°F. for dilution. Standard drainage time is determined as the result of an average of three tests using 10.6 g. of oven dry pulp per test.

Another technique that can be used, which gives accurate results, is accomplished by determining the drainage time of four different weights of pulp which fall on both sides of 10.6 g. when dry. Drainage time is plotted against ovendry pad weight and the Standard drainage time is read from the graph at 10.6 g. dry weight. The latter method was used throughout this study. All water used for dilution in these tests was maintained at 80°F.

Test Procedure

Groundwood Pulps. The drainage time of pine and willow groundwoods were determined under each of the following conditions:

1. Control, using dewatered pulp and fresh tap water for dilution.
2. Same as control, but sized with 0.5% rosin and alum to pH 5 3.
3. Using filtered white water for dilution—pulp unsized.
4. Using filtered white water for dilution and sized with 0.5% rosin and alum to pH 5.3.

Semichemical Pulps. The drainage time of neutral sulfite and cold soda pulps were determined under each of the following conditions:

1. Control, using dewatered pulp and fresh tap water for dilution.

WILLIAM G. COGGAN, Research Engineer, Wood Fiber Products Section, Johns-Manville Research Center, Manville, N. J.
* Structural Fibrous Materials Committee.

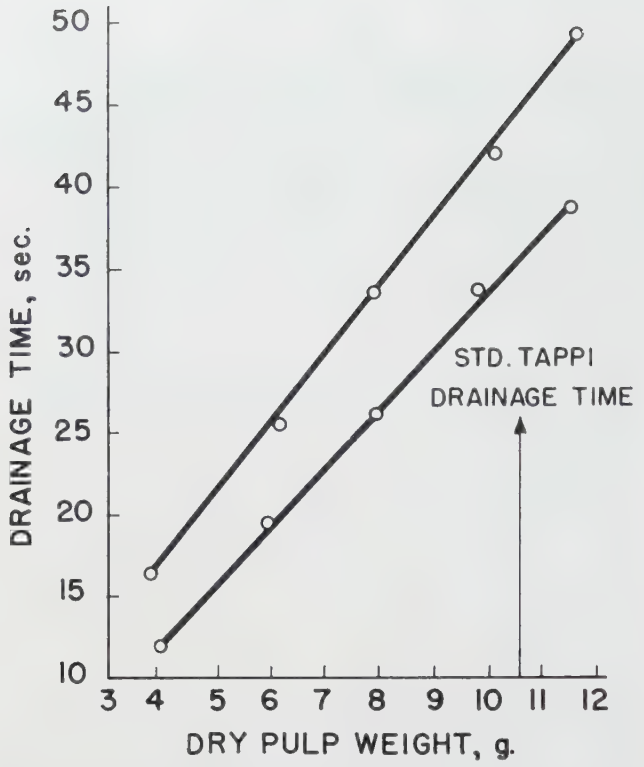

Fig. 1. Comparison of sized cottonwood-willow groundwood drainage times showing increase due to white water dilution

2. Same as control, but sized with 0.5% rosin and alum to pH 5.3.
3. Contaminated with sufficient cooking liquor to simulate a poorly washed pulp—unsized.
4. Contaminated with cooking liquor as above, but sized with 0.5% rosin and alum to pH 5.3.

The cold soda cooking liquor contained unconsumed caustic soda which was neutralized with sulfuric acid prior to sizing.

Asplund-Defibrated Pine. The drainage time of Asplund-defibrated pine pulp was determined as follows:

1. Control, using dewatered pulp and fresh tap water for dilution.
2. Same as control, but sized with 0.5% rosin and alum to pH 5.3.
3. Using white water for dilution—unsized.
4. Using white water for dilution and sized with 0.5% rosin and alum to pH 5.3.

RESULTS

The Effect of Size and Alum Addition

None of the pulps tested showed any significant change in drainage time owing to sizing when dewatered pulp samples were tested using tap water for dilution.

The Effect of Pulp Cleanliness

None of the pulps tested showed a change in drainage time when diluted with white water or contaminated with some cooking liquor to simulate poor washing. However, when the poorly washed willow groundwood and cold soda pulps were sized, their drainage times increased 25 and 44%, respectively. Figures 1 and 2 show these drainage time increases graphically. None of the other poorly washed pulps showed a drainage time change owing to sizing.

Laboratory examination of the willow groundwood white water and the cold soda liquor contaminated

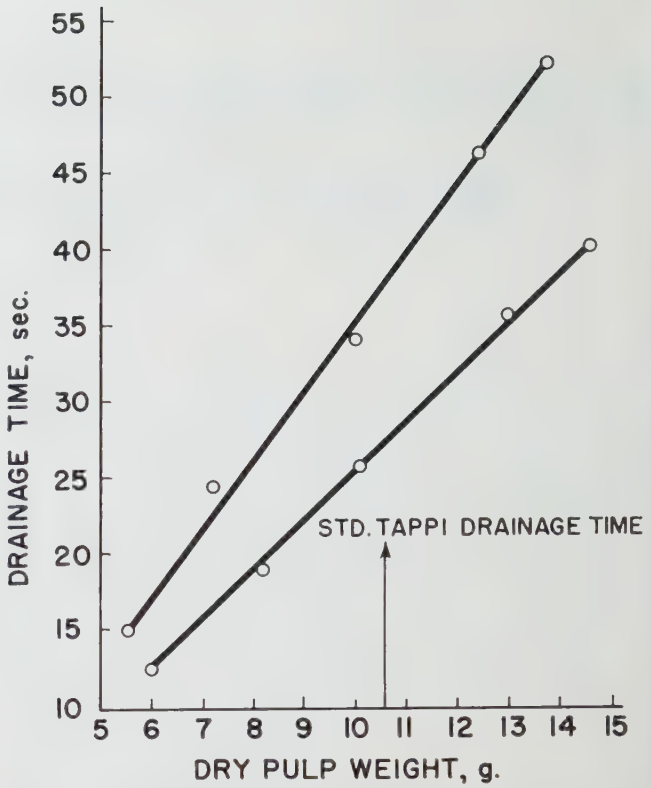

Fig. 2. Comparison of drainage times of sized cold soda pulp showing increase due to spent liquor contamination in white water used for dilution

white water showed that they both formed a gelatinous precipitate when adjusted to pH 5.0 to 5.5 with alum. This gel was probably responsible for the increase in drainage time by decreasing the porosity of the drainage pad.

Spectrographic analysis of the precipitate from the cold soda white water indicated that it was composed principally of sodium and aluminum compounds. Ashing the precipitate gave 63.5% organic materials and water of hydration and 36.5% sodium and aluminum compounds. It is assumed that with these two pulps, conditions were such that the precipitation of aluminum hydroxide was favored and the sodium and organic compounds were either coprecipitated or absorbed by the aluminum hydroxide gel. The reasons why this did not occur with the other pulps is not known.

CONCLUSIONS

Purpose of Drainage Time Test

The results of this investigation indicate that some insulating board pulps may show significant changes in drainage time, depending upon the conditions used for the test. The basic purpose of the drainage-time test is to determine the relative freeness of a pulp, which serves as an index in describing the drainage characteristics of that pulp. In the mill, drainage time is used for control purposes at such locations as the grinders, refiners, screens, deckers, and machine headbox, because experience has dictated the proper drainage time necessary for an acceptable product consistent with maximum forming speeds. In the laboratory, drainage time is used in part to describe the relative freeness of pulps being studied and also to specify one of the conditions necessary to guarantee the quality of new products being introduced to the mill. Drainage time is

also used to predict maximum forming speeds involving a new product or process with some degree of accuracy.

Standard Drainage Time

The standard drainage time of pulp is herein defined as the drainage time of the pulp itself without any influence due to additions or cleanliness of the water used for dilution. The results of this investigation indicated that the Standard drainage time was not affected by the condition of the water used for dilution. For this reason the procedure for determining the Standard drainage time (T 1002 sm-51) is, undoubtedly, reliable for laboratory work and for drainage-time control in the mill at the various sampling positions except in some cases at the forming machine headbox.

Machine Drainage Time

The results of this study have shown that the Standard drainage time of some pulps may be increased by a reaction between the dissolved solids in the white water used for dilution and the alum added during sizing. Therefore, a pulp might have a "machine drainage time" which is significantly greater than its Standard drainage time. The test results indicate, if the pulp is well washed, that the machine drainage time will agree closely with the Standard drainage time regardless of the condition of the dilution water and the addition of size and alum. The presence of this effect in existing processes could be checked by comparing the drainage time of the pulp at the headbox using white water, size, and alum in the test with the Standard drainage time using only dewatered pulp and tap water for dilution. Should any increase in drainage time be found, the conversion of the process to more thorough washing would have to be justified on the basis of the increase in machine speed made possible.

Special care should be taken in the laboratory when developing new pulps or processes that such a reaction, due to additions or environmental plant conditions not normal to the laboratory, results in a machine drainage time sufficiently different from the Standard drainage time to upset predictions involving forming machine speeds.

RECOMMENDATIONS

It is recommended that the Suggested Method of determining the Standard drainage time of pulp for insulating board (T 1002 sm-51) be expanded to include the following statement:

"The Standard drainage time of some pulps may be increased by reactions between additives, such as size and alum, and environmental conditions, such as the cleanliness of the water used for dilution. Care should be taken both in the mill and in the laboratory to include as many conditions as possible in the test, which are normal to the process, in case any discrepancy between Standard drainage time and machine drainage time exists."

LITERATURE CITED

1. Hrubesky, C. E. and Perot, J. J., *Tappi* 37, No. 10: 425–457 (Oct., 1954).
2. Reichman, E. J., *Tappi* 38, No. 7: 1194–1224 (July, 1955).
3. Graham, W. H., *Tappi* 38, No. 4: 252–255 (April, 1955).
4. Jenkins, E. M., *Tappi* 40, No. 10: 157A–160A (Oct., 1957).
5. Hrubesky, C. E., *Tappi* 32, No. 7: 315–318 (July, 1949).
6. Hrubesky, C. E., *Tech. Assoc. Papers* 31: 379–388 (1948).
7. Haig, D. R. P., *Tappi* 30, No. 1: 35–38 (Jan., 1955).

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Nitratability of Differently Treated Cotton Linters

AHMED MUSTAFA, ABDEL FATTAH DAWOUD, and YEHIA A. FAHMY

Egyptian cotton linters are contaminated with great amount of mineral impurities (12–16%). Moreover, its long fibrous character causes difficulties in handling and manipulation in the purification and nitration plants. The ash content of the kier-boiled samples (1.7–1.9%) was found to be far away from the specifications for cotton cellulose intended for cellulose nitrate manufacture (0.5%). However, bleaching effected the required reduction of ash. Acid treatment of the linters, prior to kier-boiling, gave samples with low ash content (0.2–0.3%) and high alpha-cellulose percentage (96.5–97.5%); thus rendering the bleaching step unnecessary for cotton cellulose needed for explosives manufacture. Fiber length reduction of the Egyptian linters was carried out by dry-cutting as well as beating in water and certain organic solvents, e.g., benzene and acetone. The effect of the different purification methods as well as dry-cutting, beating, shredding and water replacement of the beaten fibers on the nitratability of the treated linters have been studied.

Cotton linters have been widely used in cellulose nitrate manufacture. Most strains of cotton grown in Egypt have practically no linters on the seed, i.e., the seeds are bald (*1*). However, some strains have long fibrous linters of an average length varying from 10 to 40 mm., a matter which causes difficulties in handling and manipulation in the plant. This, and the contamination of the linters with great amounts of impurities, e.g., the mineral matter (ca. 12–16% based on dry weight), explains the inefficiency of the customary kier-boiling method for the purification of the Egyptian linters.

The present investigation deals with an approach to the purification of the Egyptian cotton linters to meet the specifications for cotton cellulose intended for cellulose nitrate manufacture, taking into consideration the economics as well as the reduction of the fiber length without affecting the properties of the nitrated cellulose.

The prehydrolysis-alkali method, which was used successfully for production of wood cellulose and for purification of agriculture residues cellulose, effecting the reduction of ash content and hemicellulose (*2*), has been attempted for the purification of Egyptian cotton linters. Low concentrations of nitric and sul-

Ahmed Mustafa, Abdel Fattah Dawoud, and Yehia A. Fahmy, Dept. of Chemistry, Faculty of Science, University of Cairo, Giza, Egypt, U.A.R

Table I. Nitratability of Differently Treated Cotton Linters

Sample →	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Treatment of cotton linters	*Kiering, followed by bleaching*	*Prehydrolysis followed by kiering and bleaching* 0.5% H_2SO_4, 40 min.	1% H_2SO_4, 15 min.	*Prehydrolysis followed by kiering and bleaching* 0.5% HNO_3, 40 min.	1% HNO_3, 15 min.	*Beating in water, followed by kiering*	*Sample 6 shredded at 50% moisture*	*Dry-cutting followed by kiering and bleaching*	*Standard sample*
Analysis of the Purified Bleaching Samples									
Ash content, %									
Nonbleached samples	1.9–2.1	0.2	0.17	0.18	0.17	2.1	...	2.0	...
Bleached samples	0.17–0.24	0.15	0.16	0.15	0.16	0.19	0.20	0.17	...
alpha-Cellulose, %	97.75	97.5	95.9	97.5	96.4	97.4	...	97.8	98.5
Copper number	0.78	0.85	1.0	0.86	1.0	0.82	...	0.78	0.8
Ether extract, %	0.22	0.26	0.24	0.23	0.25	0.27	...	0.21	0.18
Absorbency, sec.	2.0	2.0	2.0	2.0	2.0	3.0	3.0	2.0	2.0
Properties of Cellulose Nitrates with Low Nitrogen Content (Prepared with Mixed Acids I)									
N_2, %,	11.63	11.64	11.62	11.64	11.64	10.9	11.23	11.61	11.62
Yield, %	157	157	157	157	157	130	152	157	157
Matter insoluble in acetone, %	C.S.[a]	C.S.	C.S.	C.S.	C.S.	8.07	1.5	C.S.	C.S.
Solubility in ether-alcohol, %	100	100	100	100	100	92	98.5	100	100
Relative viscosity (water = 1)	3.2	3.4	2.8	3.2	2.9	...	...	3.4	3.3
Bergmann-Junk stability test, mg. N_2[b];	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Properties of Cellulose Nitrates with High Nitrogen Content (Prepared with Mixed Acids III)									
N_2, %	13.4	13.39	...	13.41	...	...	13.01	13.42	13.43
Yield, %	ca. 173	ca. 173	...	ca. 173	...	...	ca. 167	ca. 173	ca. 173
Matter insoluble in acetone, %	C.S.	C.S.	...	C.S.	...	...	1.2	C.S.	C.S.
Relative viscosity (water = 1)	4.5	4.3	...	4.4	...	...	3.9	4.5	4.6
Bergmann-Junk stability test, mg. N_2[b]	1.2	1.2	...	1.2	...	...	1.2	1.2	1.2

[a] C.S. = completely soluble.
[b] The maximum instability allowed commercially, in the case of cellulose nitrate, is that corresponding to an evolution of 1.25 mg. N_2 per gram of sample.

furic acids have been used in the prehydrolysis step.

The results are recorded for the adopted procedures for reduction of the fiber length by either: (a) wet-cutting, including beating in water and/or in certain organic solvents, e.g., acetone or benzene (*3*), or (b) dry-cutting (*4*), as well as the effect of the physical form of the differently treated samples on their nitratability. Moreover, the chemical properties of the purified samples of the Egyptian linters, as well as those of their nitrated products were compared with those of a standard sample of purified linters* used in explosives manufacture.

RESULTS AND DISCUSSION

Chemical Purification of Linters

Analysis of the Egyptian cotton linters showed the presence of an appreciable amount of impurities including fatty matter, seed coats, boil particles, and mineral impurities. The fatty matter (ether extract), the seed coats and the ash contents were found to be 2.3, 2 to 3, and 12 to 14%, respectively. Mechanical opening of the linters, followed by conveying in air stream, effected the reduction of the ash content to 4.5%.

The following procedures have been adopted for the purification of the mechanically treated linters:

A. *Alkali Method.* The opened linters were digested at 135°C. for 3 1/2 hr. using aqueous solution of 22% NaOH and 6% Na_2S based on moisture-free material, in the presence of a wetting agent (Superanol Ciba), liquor ratio 10:1. By this treatment the ash content in the purified linters was reduced to 1.7 to 1.9% in different samples. Subjecting the digested and washed samples to a hypochlorite bleach (1 g. available chlorine per liter for 1 1/2 hr. at 38°C.), followed by a souring treatment with sulfuric acid solution (0.5% for 20 min.), brought about further reduction of the ash content of the linters to values ranging from 0.17 to 0.24%. The analytical data of these purified samples meet all the required specifications for cotton cellulose to be used for explosives manufacture (*cf.* Table I) and are almost similar to those of the standard sample of purified linters.

B. *Prehydrolysis-Alkali Method.* In the course of the present investigation different concentrations of nitric and sulfuric acids solutions were used prior to kier-boiling.

High concentrations of nitric acid solutions, e.g., boiling with 2% acid for 20 min. at atmospheric pressure (liquor ratio 10:1), has been found to cause considerable degradation of the cellulose; the alkali digested product contained 82% of alpha-cellulose. On the other hand, using 0.2 to 1% HNO_3 solutions gave products with high alpha-cellulose content (*cf.* Table I). Thus, using nitric or sulfuric acids solutions of concentrations ranging from 0.2 up to 0.5% in the prehydrolysis step, followed by digestion with the alkaline liquor, gave purified samples containing 96.5 to 97.5% of alpha-cellulose. As a result of the acid prehydrolysis treatment, the alkali concentration has been reduced to 18% NaOH and 4% Na_2S based on moisture-free material. Moreover, application of this procedure has effected the reduction of the ash content of the purified samples to values ranging from 0.2 to 0.3% and, thus,

* Samples of cotton linters were supplied by Celanese Mexicana, S.A., Rio Bravo, Temps. Mexico, in accordance with U. S. Army-Navy Joint Specifications (Jan-C-206 (1945); cf. ref. (*5*)) for grade I cotton cellulose intended for use in explosives.

it is no longer essential to bleach the linters needed for explosives manufacture (the bleaching step is omitted in some factories during the processing (*6*)).

Viscosity measurements of the nitrated products, obtained from the purified samples, after procedure (A) or (B), are almost identical with those of the nitrated standard sample. Slight decrease in the viscosity is observed in the case of the nitrated products of purified samples treated with 1% nitric or sulfuric acid solutions during the prehydrolysis step (*cf.* Table I).

Reduction of Fiber Length

Cotton linters are preferred as a raw material over staple cotton (lint fibers) in cellulose nitrate manufacture. This is essentially due to (*7*): (a) greater ease of handling and manipulation in the plant, (b) less pulping required in the purification of smokeless grade cellulose nitrate.

The Egyptian cotton linters have an average length of 10 to 40 mm. (see above) which is far away from the normal average of 3 mm. for the usual mill-run cotton linters (*8*).

Reduction of the fiber length was carried out on two basis:

Wet Cutting. This was effected by beating a slurry of cotton linters in water of 2% consistency for about 30 min. using a laboratory Jokro beater. The samples were then purified after method (A). Fiber length was considerably reduced to about 3 to 7 mm. together with other beating phenomena as fibrillation. The chemical properties of the purified beated sample were found to meet the required specifications for cotton cellulose for explosives manufacture but the physical form of the sample is altered as will be discussed below (*cf.* Table I).

Dry Cutting. Dry-cutting machines effect the reduction of the fiber length of lint fibers up to ca. 4 mm. (*4*). In the present investigation, similar reduction has been brought about on a laboratory scale (ca. 4 mm.), followed by purification after procedure (A). The chemical properties of the purified samples are found to be satisfactory for explosives manufacture (*cf.* Table I).

Nitration of the Purified Cotton Linters

Cellulose nitrates of low and high nitrogen content, needed for this investigation, have been prepared by using mixed acids of the following composition:

Mixed acids I (low)—
58.22% H_2SO_4, 24.47% HNO_3, 17.31% H_2O.
Mixed acids II (low)—
59.45% H_2SO_4, 24.05% HNO_3, 16.5% H_2O.
Mixed acids III (high)—
69.08% H_2SO_4, 23.44% HNO_3, 7.48% H_2O.

The nitrated products were stabilized by boiling with water for 40 to 70 hr. followed by boiling with dilute sodium carbonate solution after the procedure described for the industrial stabilization treatment (*9*).

The nitrogen contents of the low and the high nitrated samples, purified after method (A) or (B) were found to be 11.6 to 11.64%, respectively (Table I). Furthermore, the yields of the nitrated products are almost similar, ca. 157 and ca. 173%, respectively. The yield percentage, in both cases, approaches the theoretical values,† i.e., 159.5% for cellulose nitrate with 11.6% nitrogen and 175.7% for nitrated cellulose with 13.4% nitrogen.

Whereas, dry-cutting followed by purification after method (A), seems to have exerted no appreciable effect on the nitrogen content, yield, and properties of the nitrated products, wet-cutting (i.e., beating before kiering) leads to the formation of products with low nitrogen content (10.9% as compared with 11.6%, *cf.* Table I). Moreover, in the latter case ca. 8% of the cellulose nitrate is insoluble in acetone. The yield of the nitrated product amounted only to 121%; a value which is far below the theoretical one, i.e., 153.9% for cellulose nitrate with 10.9% nitrogen.

It was realized early that the physical properties of cellulose are, as well, important as its chemical purity in obtaining satisfactory nitration, i.e., the physical form in which the cellulose is nitrated has a marked effect on its nitratability (*10*). In the early attempts to nitrate wood pulp it was observed that the yield of cellulose nitrate was only about 120% as compared with 150% for cotton cellulose. Nevertheless, since then considerable progress has been successfully made in the development of methods for putting wood pulp into suitable physical form for nitration. It is also evident that beating changes the physical structure of the fiber. The beaten fibers after drying are no longer as porous as they were before beating‡ (*11*), and the dried fibers become cemented together.§ When the dry, beaten cotton linters are, thus, nitrated with the usual mixed acids used for nitration of fluffy linters, it is to be expected that penetration of the acids into the mass is slow and hence, complete nitration of the fibers within the usual time of nitration does not occur.

When the beaten sample was shredded at 50% moisture (*13*), in a Werner-Pfleider shredder for 30 min. and re-dried, the material retained its fluffy and loosed structure. When the shredded sample was nitrated, it was found that the yield of the nitrated product approached the theoretical value and is considerably much greater than that of the beaten pulp (152 and 121%, respectively), and the insoluble matter in acetone is ca. 1.5%. The nitrogen content of the nitrated shredded sample is more than the beaten sample (*6*) though it is lower than the unbeaten linters (*1*) (11.23, 10.9, and 11.63%, respectively; *cf.* Table I). A matter which agrees with the observation that the beaten cellulose becomes less reactive than the unbeaten material (*14*).

Trials to enhance the reactivity of the shredded fibers by displacement of water by methanol, ether, and then benzene now have been carried out. The treated fibers, after being dried, were nitrated with the mixed acids (II); there was no marked increase in nitrogen content and in yield. Further study (*cf.* the inclusion method after Staudinger (*15*)) is in progress.

Kress and Bialkowsky (*3*) pointed out that beating in liquids of lower polarity than water exerts mostly a cutting effect on the fibers but causes no considerable fibrillation, and thus, on evaporation of the liquids no considerable coherence among the different fibers takes place as in the case of water. Consequently, the

† Theoretical yield for the trinitrate (14.14% nitrogen) is 183.3%.
‡ The air spaces during the beating process have been largely closed producing hardness in the mass.
§ Compare the hypothesis, that strong forces of surface tension developed between the interfaces of the hydrated cellulose layers of the adjacent fibers and fibrills draw their surfaces close together during drying, that secondary agencies come into play and even recrystallization is involved (12).

Table II. Effect of Beating on Nitratability of Cotton Linters

Sample →	*1*	*2*	*3*	*4*	*5*	*6*	*7*
Treatment of cotton linters	*Kiering followed by bleaching*	*Sample 1 treated with benzene and re-dried*	*Sample 1 beaten in acetone*	*Sample 1 beaten in benzene*	*Sample 1 beaten in water followed by shredding*	*Sample 5 followed by replacement by methanol, ether, and benzene, and re-dried*	*Standard sample*
	Properties of Cellulose Nitrates Prepared with Mixed Acids II						
N_2, %	12.20	12.21	12.22	12.24	11.87	11.87	12.22
Solubility in ether-alcohol, %	100	100	100	100	98	98	100
Relative viscosity (water = 1)	3.5	3.6	3.5	3.4	3.0	3.0	3.5
Bergmann-Junk stability test, mg. N_2	0.9	0.9	0.9	0.9	0.9	0.9	0.9

reactivity of the beaten fibers in acetone and benzene should be better than the fibers beaten in water. By investigating the effect of beating the Egyptian linters in certain organic solvents, e.g., acetone, benzene, on nitratability of cellulose, it was found that this is indeed the case and the linters give cellulose nitrates of the same properties as those of the unbeaten fibers (*cf.* Table II).

EXPERIMENTAL

Purification of Linters

Prehydrolysis. The linters were prehydrolyzed with nitric or sulfuric acids solutions under the conditions summarized in Table I. Samples were added to acids solutions, previously boiled, in a beaker at atmospheric pressure.

Kiering. Samples of 80 g. of cotton linters were digested in a rotary autoclave of 1-liter capacity, time of heating to maximum temperature, about 1 hr. Time at maximum temperature (130 to 135°C.) was $3^1/_2$ hr.; liquor ratio 10:1.

Bleaching. One-step hypochlorite bleach was applied at 8% consistency. Sodium hypochlorite solution was used (1 g. available chlorine per liter) at 35 to 38°C., for $1^1/_2$ hr., during which time the pH of the solution was kept at ca. 11.

Analysis of Linters

Determination of alpha-cellulose, copper number, ether extract, and ash content were carried out as follows. Alpha-cellulose was determined according to TAPPI Standard T 203 m-44; the copper number after the Schwalbe-Hägglund method (*16*); the fatty matter by extraction with ethyl ether in a Soxhlet apparatus for 8 hr.; and the ash content by incinerating 2 g. in a platinum crucible.

Absorbency. One gram of cotton linters is rolled to a ball and placed on the surface of water in a beaker. Time of sinking is then noted.

Nitration

For the preparation of cellulose nitrates, the following exemplifies the procedure: In a stainless-steel vessel, 50 g. of well-dried linters were treated with the mixed acids (I) and (II) in the case of cellulose nitrates with low nitrogen content (11.6 to 12.2%), and with (III) in the case of cellulose nitrates with high nitrogen content (ca. 13.4%). Nitration was carried out at 30°C. and for 45 min. in the first case and for 30 min. in the second (i.e., high nitrated). Cellulose:medium was 1:50 by weight.

The low nitrated samples were boiled with distilled water for about 40 hr. followed by boiling with slightly alkaline water (0.02% sodium carbonate solution) for 8 hr. to effect their stabilization. The high-nitrated products were boiled with distilled water for 70 hr. followed by boiling with 0.02% sodium carbonate solution for 24 hr. during which time the solution was kept faintly alkaline. The treated samples were then washed thoroughly with water and dried at 45°C. for 48 hr.

Testing of Cellulose Nitrates

Nitrogen Content. This was determined by the nitrometer method (*17*).

Solubility in Ether-Alcohol. One gram of dry cellulose nitrate was weighed out into a 250-ml. glass cylinder and 108 ml. of alcohol was added and the cylinder filled with ether up to the 250-ml. mark (*18*). The sample was shaken for 2 hr., allowed to stand overnight, after which 100 cc. was withdrawn by means of a pipet and evaporated in a tared glass dish on the water bath. It was then dried at 80°C., cooled in a desiccator and weighed to constant weight. The per cent soluble matter was calculated.

Viscosity. One-gram dry sample of cellulose nitrate was placed in a cylinder containing 100 ml. of pure acetone. After mechanically shaking for 4 hr. the solution was left to stand for 1 hr.

The Ostwald capillary viscometer was used for measuring the time of flow (seconds) of the solutions of cellulose nitrates. In all viscosity determinations the same viscometer was used and temperature was maintained, during the measurements, at 25°C. The time of flow of distilled water was measured and the relative viscosity of the cellulose nitrate solution was, thus, determined.

Bergmann-Junk Stability Test. In the official Bergmann-Junk test, 2 g. of the explosive of the cellulose nitrate type are heated at 132°C. (±0.5°C.) for a period of two hours, at the end of which the quantity of nitric oxide evolved per gram of sample is quantitatively determined as a measure of the stability of the explosive under examination. Results are usually given in milligram of nitrogen per gram of sample. During the present work, all the essential features described for the Bergmann-Junk test (*19*) were preserved.

LITERATURE CITED

1. American Cotton Handbook, Inc., New York, 1941, p. 128; see Martin, A. F., in Ott, E., ed., "Cellulose and Cellulose Derivatives," Part *II*, Interscience Publishers, Inc., New York, 1954, p. 556.
2. Jayme, G. and Schorning, P., *Holz. als Roh. u. Werkstoff* 3, 273 (1940).
3. Kress, O. and Bialkowsky, H., *Paper Trade J.* 93, No. 20, 35 (Nov. 12, 1931).
4. Reeves, R. E. and Giddens, J. E., *Ind. Eng. Chem.* 39, 1303 (1947).

5. Kirk, R. E. and Othmer, D. F., "Encyclopedia of Chemical Technology," Vol. 3, Interscience Publishers, Inc., New York, 1949, p. 355.
6. Thorpe, J. F. and Whitley, M. A., "Dictionary of Applied Chemistry," Vol. IV, Longmans, Green and Co., London, 1947, p. 506.
7. Ott, E., "Cellulose and Cellulose Derivatives," Part II, Interscience Publishers, Inc., New York, 1954, p. 715.
8. Wyck, P. V., in Bailey, A. E., ed., "Cottonseed and Cottonseed Products," Interscience Publishers, Inc., New York, 1948, pp. 894–905.
9. Kirk, R. E., and Othmer, D. F., "Encyclopedia of Chemical Technology," Vol. 6, Interscience Publishers, Inc., New New York, 1951, p. 37.
10. Reference (*7*), pp. 715–718.
11. Reference (*7*), p. 646.
12. Heuser, E., "The Chemistry of Cellulose," John Wiley & Sons, Inc., New York, 1947, p. 56.
13. Schur, M. O., and Hoos, B. G., *Ind. Eng. Chem.* 29, 26 (1937).
14. Reference (*7*), p. 621.
15. Staudinger, H., *Makromol. Chem.* 9, 148 (1953).
16. Stephenson, J., "Pulp and Paper Manufacture, Preparation and Treatment, of Wood Pulp," vol. 1, McGraw-Hill Book Co., Inc., New York, 1950, pp. 1021–1023.
17. Befor's, A. B., "Analytical Methods of Powders and Explosives," Bofors Nobelkrüt, Sweden, 1939, p. 15.
18. *ibid.*, p. 17.
19. Reference (*6*), p. 575.

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Polysaccharides in the Inner Bark of White Spruce

T. J. PAINTER and C. B. PURVES

This work was undertaken in an attempt to classify the polysaccharides present in the inner bark of white spruce (*Picea glauca*), and to compare them with those in the wood of this plant. The extractive-free inner bark of autumn-felled trees was extracted with cold water, followed by a hot aqueous buffer at pH 7. The residue was bleached with chlorous acid, and then extracted successively with 5, 10, and 18% aq. sodium hydroxide. From the extracts, by the graded precipitation of copper complexes, selective enzymic hydrolysis, and other methods, six chemically distinct groups of polysaccharides were isolated. On hydrolysis these yielded, respectively, (a) galactose, glucose, and mannose, (b) xylose and arabinose, (c) galactose, (d) arabinose, (e) glucose, and (f) galacturonic acid. Fractions (a), (b), (c), and (d) were examined by electrophoresis, sedimentation, and methylation, and some structural features are discussed. Fractions (e) and (f) were shown to be related to starch and pectic acid, respectively, by their physical constants and their behavior with diastatic and pectinolytic enzymes. The possible distribution of these components in and between the cells was suggested. It was concluded that the inner bark contained (i) starch, mainly in the form of granules, (ii) much pectic material, consisting of pectinic acid, galactan, and araban, and (iii) hemicellulosic material, consisting of xylan and mannan components similar to those of wood.

During the past decade, progress in the chemistry of hemicelluloses has been such that it is now possible to classify the major hemicellulosic components of wood on a basis of chemical structure. Similar progress has been made with the water-extractable polysaccharides of many coniferous woods. Hitherto, no systematic attempt appears to have been made to divide the total polysaccharidic fraction of a bark into its components, although it has long been recognized that barks are very rich in polysaccharides other than cellulose.

For example, barks appear to contain a well-defined hemicellulosic fraction. Thus, in 1930, Schwalbe and Neumann (*1*) detected large amounts of readily hydrolyzable hexosans and pentosans in the inner barks of spruce, pine, and red beech; and in 1938, Buston and Hopf (*2*) reported the presence in ash bark of 20% of hemicellulosic material which, upon hydrolysis gave galactose, mannose, and arabinose. In 1947, Cram and co-workers (*3*) detected glucose, mannose, galactose, and xylose in hydrolyzates of barks from western red cedar, and reported that one third of the glucose had originated from the hemicellulosic fraction. More recently, in 1955, Chang and Mitchell (*4*) carried out analyses on the barks of many North American pulpwood trees; the extractive-free bark of black spruce, for example, was found to contain residues of glucose (64%), galactose (6%), mannose (7%), arabinose (11%), and xylose (9%).

In addition to hemicelluloses, many barks appear to be very rich in pectic substances (*1, 2*). Ash bark (*2*) contained 7% of pectic material, and balsam bark was found by Hay and Lewis (*5*) to contain 14% of a "water-soluble mucilage" in addition to other carbohydrates. In 1938–39, Sharkov and co-workers published a series of papers (*6, 7, 8*) on pectic materials in the inner barks of pine, fir, and birch. Pine bast was reported to contain up to 35% of pectin. Although some of his fractions were high in methoxyl content, Sharkov concluded that pectic acids from some barks were only slightly esterified with methanol, and hence lacked the gelling power of fruit pectins.

Anderson and co-workers have also studied the pectin components of both inner bark (*9*) and the adjacent cambial zone (*9, 10*); 10% of pectic material was isolated from the inner bark of black spruce (*11*). More recently, in 1956, Kotásek found that hydrolysis of an aqueous extract of spruce bark yielded D-galacturonic acid, in addition to arabinose, glucose, galactose, xylose, and rhamnose (*12*).

The carbohydrate gums constitute another group of polysaccharides which can be associated with barks (*13*). The best known of these are the "gum exudates," which in many cases arise from mechanical damage to, or parasitic infection of, the exterior of the tree, although in some instances exudation appears to take place spontaneously (*13*). It can perhaps be argued that the gum exudates are not necessarily "normal"

T. J. Painter, Harold Hibbert Memorial Fellow, 1958, Division of Industrial and Cellulose Chemistry, McGill University: present address, The Lister Institute of Preventative Medicine, Chelsea Bridge Road, London, S.W.1, England. C. B. Purves, Chief, Division of Wood Chemistry, Pulp and Paper Research Institute of Canada, Montreal, Que.

components of bark, but similar polysaccharides are known to be present in some barks, where they undoubtedly fill a normal physiological role. A well-known example is "slippery elm mucilage," which occurs in the inner bark of *Ulmus fulva* to the extent of 16% or more (*14*). It is secreted in the bark "in sac-like membranes, considerably larger than the surrounding cells, and scattered irregularly throughout the tissue" (*16*). This mucilage has been shown by Anderson (*14*), and by Hirst and co-workers (*15*, *16*, *17*) to contain residues of D-galacturonic acid, D-galactose, 3-*O*-methyl-D-galactose, and L-rhamnose. Öiseth estimated that these residues were present in the amounts of 43.8, 22.4, 16.8 and 16.1%, respectively (*18*). Partial hydrolysis of the mucilage led to the isolation of an aldobiouronic acid, which was identified as 2-*O*-α-D-galacturonopyranosyl-L-rhamnose (*15*). Application of the exhaustive methylation technique showed that the D-galacturonic acid residues were linked through positions 1 and 4; some of the D-galactose residues were linked through positions 1 and 4, while the others were linked through positions 1 and 3. The L-rhamnose residues were linked mainly through positions 1 and 2, but occasionally also through position 3. The end-groups in the macromolecule were D-galactopyranose residues (*16*).

The high content of D-galacturonic acid residues (43.8%) in slippery elm mucilage leads to the surmise that other mucilaginous materials which have been isolated from barks, and which have been termed "pectic material" may be more closely related to the elm polysaccharide than to fruit pectins. The isolation of the above-mentioned aldobiouronic acid proves that slippery elm mucilage is not simply a mixture of a polygalacturonic acid and other polysaccharides, and a recent unsuccessful attempt (*19*) to fractionate the mucilage into dissimilar components adds support to the previous view that a single, complex macromolecule is involved.

Another interesting gum was recently isolated from the inner bark of red fir, by Becker and Kurth (*20*). Upon hydrolysis, it yielded glucuronic acid, glucurone, an aldobiouronic acid, galactose, arabinose, and two other sugars which were tentatively identified as 6-deoxy-glucose and 6-deoxy-idose, respectively. Methylation studies showed that the gum had a highly branched structure.

Inner barks, especially those of autumn-felled trees, usually contain considerable quantities of starch. Larsen and Lynn (*21*) detected starch in the bark of western larch, and Anderson and Pigman have reported its presence in the inner bark of black spruce (*9*). Histological studies show very clearly that starch granules, similar to those of cereal starches, are present in the parenchymatous cells of bark (*22*, *23*), where they undoubtedly act as a food-reserve. It will be recalled that Campbell (*24*) observed a similar phenomenon in oak sapwood, and found that, in addition to starch granules, other starchlike material appeared to be distributed in the cellwalls, in close association with uronic acid-containing material.

In the extraction of polysaccharides from bark, a number of special problems arise which are not encountered with wood. The presence of suberin in bark interferes with lignin determinations, and can impede the extraction of polysaccharides by aqueous reagents. Another difficulty is that the barks of many trees are very rich in tannins and the higher molecular weight "phlobaphenes" or "phenolic acids." Whereas some of these materials can be removed by extraction with organic solvents, others remain with the fibrous residue, and are subsequently extracted, together with the polysaccharides, by aqueous solvents. These phenolic substances are readily oxidized by air, and polymerized by acids, alkalis, or heat, to furnish black, insoluble tars which contaminate the polysaccharide fractions. Fortunately, these contaminants can be removed with ease by treatment with chlorous acid, but this reagent is known to degrade pectic acid extensively (*25*), and probably also other polyuronides, of which bark, unlike wood, contains an abundance. Also, of course, the acidic conditions involved in such treatment are liable to cleave labile glycosidic linkages; barks appear to be rich in arabinose residues, which frequently occur in the labile furanose form. In the present work, bleaching with chlorous acid could not be avoided, and for this reason, the polysaccharides isolated are not necessarily representative of the native material; however, they have significance if considered as fragments of possibly more complex parent polymers.

In conclusion, attention must be drawn to the possibility that some polysaccharides in bark may be chemically linked to noncarbohydrate materials such as tannin, lignin, or other substances. Slippery elm mucilage, for example, contains about 10% of a non-carbohydrate body (*14*) which cannot be removed by normal procedures for purification, and which is isolated as a brown, insoluble residue after hydrolysis of the mucilage with acid (*15*). The residue contains nitrogen and sulfur.

DESCRIPTION OF THE PRESENT WORK

This research was undertaken in an attempt to isolate as many chemically distinct polysaccharide fractions as possible from the inner bark of white spruce (*Picea glauca*), and where possible, to determine their general structural features. In this way, it was hoped to classify them, and to compare them with the polysaccharides of wood. It was also hoped to obtain some indication of their location in and between the cells. Previous work in these laboratories has already led to the isolation from the whole bark, of pure pectic acid and starch (*26*), and a polysaccharide fraction containing residues of D-galactose and L-arabinose (*27*).

The bark of autumn-felled white spruce trees was cut into small pieces, and extracted exhaustively with organic solvents to remove as much tannin as possible, as well as other extractives. It was then swollen by soaking in cold water, whereupon it became possible to separate the inner bark from the outer bark by hand. The outer bark was not examined. The inner bark was macerated with cold water to give a brown pulp, consisting of long fibers. The pulp was quite slimy to the touch, suggesting that it was rich in mucilaginous material. During the maceration, some of the cells were ruptured, with the liberation of many minute particles which were stained blue by iodine; they were isolated, and shown to be starch granules.

In order to remove as much water-soluble tannin as possible, the pulp was washed thoroughly with cold

water; a similar technique was used by Campbell (*24*) to remove tannins from oak sapwood, prior to the extraction of starch by hot water. The residue was then extracted exhaustively by stirring it with hot aqueous buffer at pH 7. The extract was bleached briefly with chlorous acid, concentrated, and poured into acetone, to yield a mixture of polysaccharides which represented about 14% of the extractive-free inner bark. Hydrolysis of this product, followed by chromatography of the hydrolyzate, indicated the presence of galacturonic acid, galactose, glucose, and arabinose as the major components, together with traces of rhamnose and other unidentified sugars.

When cupric acetate was added to an aqueous solution of the mixture, about half of the material was precipitated as a gelatinous copper complex. From the precipitate, a polysaccharide was recovered which was rapidly degraded by a pectinase enzyme to give a high yield of D-galacturonic acid, in addition to smaller amounts of galactose and arabinose. From the supernatant solution, a mixture of polysaccharides (product A) was recovered which now contained only small amounts of galacturonic acid residues.

The residual fiber was then suspended in hot water, and bleached with sodium chlorite and acetic acid. From the chlorite liquor, a further quantity of polysaccharides was recovered (product B), which upon hydrolysis yielded the same sugars as A. The holocellulose was extracted successively with 5, 10, and 18% aqueous sodium hydroxide, to yield products C, D, and E, respectively, together with the residual α-cellulose. Hydrolysis of C, D, and E yielded in each case the same sugars as A and B, but relatively large amounts of mannose and xylose were also detected, together with traces of 4-*O*-methylglucuronic acid. In Table I, the distribution of the major sugar residues in C, D, and E is indicated in a qualitative manner. Hydrolysis of the α-cellulose yielded traces of mannose in addition to glucose.

As it seemed probable that much of the material in these alkaline extracts was similar to that in products A and B, an attempt was made to separate such material from the xylose and mannose-bearing polysaccharides, which had appeared for the first time in the alkaline extracts. This object was accomplished by adding Fehling s solution to a solution of C, D, and E in dilute alkali. A gelatinous copper complex was precipitated, from which a polysaccharide fraction F was regenerated. Chromatography of a hydrolyzate of F indicated the presence of galactose, glucose, mannose, xylose, arabinose, and traces of 4-*O*-methylglucuronic acid. When an equal volume of ethanol was added to the supernatant solution, a second copper complex was precipitated, from which a polysaccharide fraction G was recovered. Chromatography of a hydrolyzate of G indicated the presence of galactose, glucose, arabinose, and traces of rhamnose and other unidentified sugars, but no xylose or mannose was detected. From the remaining supernatant solution, a small quantity of material was recovered (product H), which appeared to consist of degraded pectic acid.

Examination of Products A, B, and G

All three of these products contained residues of galactose, glucose, arabinose, and traces of rhamnose and other unidentified sugars. They were stained deep blue by aqueous iodine, but when they were treated in aqueous solution with α-amylase they rapidly lost this property, and when the enzyme-resistant polysaccharides were recovered and hydrolyzed, they were found to be completely devoid of glucose residues. They now contained galactose and arabinose as the only major sugar residues, in the respective ratios of 3:2 for A, 1:1 for B, and 1:6 for G.

Table I. Sugars in Hydrolyzates of Bark Fractions C, D, E

Fraction	NaOH, % w/v	Arab.	Gal.	Gal.-A	Gluc.	Xyl.	Mann.
C	5	+++	++	+	+++	++	+
D	10	+	++	tr.	++	+++	++
E	18	tr.	+	−	++	+++	+++
Alpha-cellulose	Residue	−	−	−	+++	−	tr.

Arab. = arabinose. Gal. = galactose. Gal.-A. = galacturonic acid. Gluc. = glucose. Xyl. = xylose. Mann. = mannose. tr. = trace amount.

This difference in the ratios suggested that at least two components were involved, one of which contained galactose as the predominant sugar residue, while another was composed mainly of arabinose residues. Electrophoresis of A, B, and G on fiberglass sheets (*28*) yielded in each case two distinct bands. When the substances responsible for these bands were eluted from the sheets and hydrolyzed, one gave galactose as the only detectable sugar, while the other yielded arabinose. Samples from which starch had not been removed gave a third band, which remained at the starting-line; this band was stained blue by aqueous iodine and yielded glucose on elution and hydrolysis. (Small amounts of other sugar residues may have been present in the bands, but it was not possible to separate sufficient material electrophoretically to spot the chromatograms heavily.)

To prepare a sample of the galactan, product A was chosen, and the starch was removed with α-amylase. The success of the electrophoretic separation, which was carried out in a borate buffer, suggested that a method for separating the galactan from the araban should be based upon the different capacities of these components to form complexes with borate ions. The Cetavlon-borate method of Barker and co-workers (*29*) suggested itself, and the modification of Bouveng and Lindberg (*30*) was found the most satisfactory.

The galactan isolated in this way had $[\alpha]_D$ −22° in water, and on hydrolysis yielded over 90% of galactose, together with small amounts of arabinose, rhamnose, and other unidentified sugars. The galactan was methylated; the product, after purification by precipitation from chloroform-ligroin, gave a negative test for methylated pentosan, and yielded galactose only upon demethylation and hydrolysis.

The methylated galactan was hydrolyzed with formic acid; the products were separated chromatographically into (i) tetra-*O*-methyl-galactose (6 parts), (ii) tri-*O*-methyl-galactoses (8 parts), (iii) di-*O*-methyl-galactose (3 parts), and (iv) mono-*O*-methyl-galactose (1 part).

To prepare a sample of the araban, product G was used, and after purification by the Cetavlon-borate method, it had $[\alpha]_D$ −70° in water, and contained over 90% of arabinose residues. This component has not been further examined.

Examination of Product F

This product contained residues of galactose, glucose,

mannose, and xylose in the approximate ratio 1:2:2:1, together with traces of arabinose and 4-*O*-methylglucuronic acid. An aqueous solution of the material gave a brown color with iodine, but this property was not lost upon treatment with α-amylase, nor did the optical rotation of the solution change upon such treatment. When subjected to electrophoresis, the mixture separated into two discrete bands. The slower-moving band was stained brown by iodine, and upon elution and hydrolysis, yielded glucose, xylose, and arabinose. The faster-moving band yielded galactose, glucose, and mannose. No band corresponding to the starch present in previous fractions was detected.

Great difficulty was experienced in attempting to separate in bulk the two electrophoretically distinct groups of polysaccharides. Barium hydroxide, which has been used to separate wood glucomannans from xylans (*31*), failed to give a precipitate when added to an aqueous solution of F, and no separation was achieved by the graded precipitation of copper complexes (*19*). However, by repeated use of the Cetavlon-borate method, two small, chemically distinct fractions were obtained. One of these had $[\alpha]_D$ −12° in water, and contained residues of galactose, glucose, and mannose in the ratio 1:2:9, while the other had $[\alpha]_D$ +45° in water, and contained residues of glucose, xylose, and arabinose in the ratio 15:9:1. Both fractions gave single, broad peaks in the ultracentrifuge, and showed the extensive spreading of the boundary characteristic of highly polydisperse materials. Neither fraction was attacked by α-amylaze, but the xylose-containing fraction was digested slowly by takadiastase, with the liberation of glucose, and traces of xylose and arabinose. The enzyme-resistant residue now had $[\alpha]_D$ −5° in water, and contained residues of glucose, xylose, and arabinose in the ratio 5:20:1.

To prepare the fully methylated derivatives of the "mannan" and "xylan" components, product F was first treated with takadiastase until no more glucose was liberated. The enzyme-resistant residue was then methylated, and the product was separated by fractional precipitation into two chemically distinct fractions. One gave a negative test for methylated pentosan, and yielded mannose on demethylation and hydrolysis, while the other yielded xylose on demethylation and hydrolysis.

Hydrolysis of the methylated mannan afforded (i) 2,3,4,6-tetra-*O*-methyl-D-mannose (1 part), (ii) 2,3,4,6-tetra-*O*-methyl-D-galactose (2 parts), (iii) 2,3,6,-tri-*O*-methyl-D-mannose (35 parts), (iv) 2,3,6-tri-*O*-methyl-D-glucose (7 parts), and (v) di-*O*-methyl-hexoses (3 parts).

Hydrolysis of the methylated xylan afforded 2,3-di-*O*-methyl-D-xylose (35 parts) and 2,3,4,-tri-*O*-methyl-D-xylose (1 part), together with another component (1 part) which may have been 2,3,5-tri-*O*-methyl-arabinose.

EXPERIMENTAL

Paper chromatography was carried out on Whatman no. 1 filter paper; the solvent was either (a) ethyl acetate–acetic acid–formic acid–water (18:3:1:4 v/v), (b) butan-1-ol–pyridine–water (6:4:3 v/v), or (c) butan-2-one–ethanol–water (85:4:11 v/v). Sugars were located on the chromatograms with the *p*-anisidine hydrochloride reagent (*32*).

Electrophoresis of polysaccharides was carried out on fiberglass sheets (*28*) (40 × 10 cm.) with 0.2 *M* sodium borate as the electrolyte. A potential difference of 600 v. was applied, and the current (25–30 ma.) was passed for 3 to 5 hr. To detect the polysaccharides on the electrophoretograms, the strips were first dried, then sprayed with aqueous acetic acid (50% v/v), and dried again. They were next sprayed with 0.01 *M* sodium metaperiodate until uniformly moist, and heated at 80°C. for 15 min., after which they were sprayed with aqueous starch-potassium iodide (*33*). Starch was detected selectively by spraying with 0.01 *N* iodine.

Optical rotations were determined at 22 ± 2°, and unless otherwise stated, the solvent was water. Melting points were determined with a Kofler block. Solvents were evaporated under diminished pressure, at 30 to 45°C.

The relative proportions of sugar residues in the polysaccharide fractions were determined by complete hydrolysis in 2 *N* sulfuric acid at 100°C. for 20 hr., separation of the hydrolysate by chromatography, and estimation of each sugar by either periodate oxidation (*34*) or iodometric titration (*35*).

The ultracentrifuge was a Spinco Model E instrument, and was operated at 59,780 r.p.m.; the cells were charged with 2% w/v aqueous solutions of the polysaccharides. Enzymes were purchased from the Nutritional Biochemicals Corp., except takadiastase, which was supplied by Parke, Davis & Co.

Aqueous solutions of polysaccharides which were contaminated with tannins were bleached at 80°C. by the dropwise addition, with stirring, of aqueous chlorous acid. The chlorous acid was prepared by passing aqueous (4% w/v) sodium chlorite through a column of Amberlite IR-120 resin. To test for carbohydrates in aqueous solutions containing tannins, portions were bleached with chlorous acid at 80°C., cooled, treated with sodium bisulfite, and then subjected to the Molisch test in the ordinary way.

Extraction of the Bark

The bark was received at the laboratory shortly after having been stripped, by means of draw knives, from autumn-felled white spruce trees of average age 75 to 100 yr. It was carefully freed from pieces of adhering wood, cut into small squares (4 × 4 cm.), and air-dried at room temperature. It was then extracted exhaustively with benzene-ethanol (2:1 v/v), followed by pure methanol, in a Soxhlet extractor.

The extractive-free bark (1.8 kg.) was soaked in cold water (10 l.) for 3 days. The steep water contained tannins, but only traces of carbohydrate, and it was hence discarded. The inner bark was then peeled, with the aid of a penknife, from the outer bark, which was not further examined. By weighing a representative portion before and after drying, it was estimated that a dry weight of 320 g. of inner bark had been obtained. The pieces of inner bark were macerated in a Waring Blendor with cold water (10 l.), and yielded a slimy brown pulp consisting of long fibers, which were collected by filtration through gauze.

Isolation of Starch Granules. The filtrate consisted of a suspension of fine particles. Part of this material was fibrous débris, but some of the particles were

stained deep blue by aqueous iodine. They were collected (centrifuge), washed well with cold water, and then heated with water (100 ml.) at 90°C. The mixture was filtered through Celite, and the filtrate was poured into ethanol (300 ml.). The precipitate was collected and dried by solvent exchange (yield, 0.3 g.). The product had $[\alpha]_D$ +190°, and yielded glucose and traces of other sugars on acid hydrolysis. An aqueous solution was stained deep blue by iodine, but upon treatment with α-amylase, this property was lost at a rate identical with that shown by a similar solution of potato starch. Subsequent treatment with β-amylase yielded in each case products with the chromatographic mobilities of glucose, maltose, and maltotriose.

Isolation of Water-Extractable Polysaccharides. The fibrous mass was allowed to soak in cold water (10 l.) for 2 days. This treatment was repeated twice, after which little further colored material appeared to enter solution. The extracts (30 l.) and the water used for maceration (10 l.) were combined. The total 40 l. of solution was estimated to contain *ca.* 3 g. of polysaccharides by bleaching a portion with chlorous acid, concentrating, pouring the concentrate into ethanol, and weighing the precipitate. Since acid hydrolysis of the portion isolated gave the same sugars as subsequent extracts, the remainder of the material was not recovered.

The fiber was next extracted by stirring in aqueous (1% w/v) potassium acetate (10 l.) at 70°C. for 3 hr., then collected by filtration, and extracted twice more in the same way. The combined extracts (30 l.) were bleached with chlorous acid, neutralized with sodium sulfite, concentrated to 3 l., and poured into acetone (15 l.). The precipitated polysaccharides (45 g.) were collected and dissolved in water (2 l.). Saturated aqueous cupric acetate was added to this solution until no further precipitation occurred. The gelatinous precipitate was collected (centrifuge), washed with ethanolic ammonia until copper free (colorless washings), then with acetone, and airdried.

Isolation of Pectic Acid. The product (21 g.) appeared to be the ammonium salt of an acidic polysaccharide. Upon hydrolysis with aqueous (0.2% w/v) pectinase, it yielded galacturonic acid, together with minor amounts of galactose and arabinose, and traces of rhamnose and other unidentified sugars (chromatographic detection). It was purified by thrice converting it into its copper salt, followed by regeneration with ethanolic ammonia. The product (30% yield), when hydrolyzed with pectinase, yielded *ca.* 90% of syrupy D-galacturonic acid, $[\alpha]_D$ +60°, characterized by oxidation with bromine water to mucic acid, m.p. and mixed m.p. 210 to 220° (decomp.). A sample of the free pectic acid, obtained by washing the ammonium salt with acetone acidified with concentrated hydrochloric acid (1% v/v), had $[\alpha]_D$ +210° in 0.1 *N* sodium hydroxide.

The supernatant solution remaining after the initial precipitation of the pectic acid with cupric acetate was dialyzed against running water until copper free, concentrated to 1 l., and poured into ethanol (3 l.). The precipitated material was recovered in the usual way, giving 16 g. of a light brown powder (product A). Chromatography of an acid hydrolyzate of A indicated the presence of galactose, glucose, and arabinose, together with minor amounts of galacturonic acid and rhamnose, and traces of other unidentified sugars.

The residual fiber was then suspended in water (10 l.), and bleached at 80°C. with sodium chlorite (200 g.) and glacial acetic acid (200 ml.) for 1 hr. The holocellulose was collected by filtration, washed with water, then with acetone, and airdried. The product, which was pure white except for numerous small, black specks, weighed 205 g. These specks could be bleached by prolonged treatment with acidified chlorite, but this was not done. The chlorite liquor (10 l.) was neutralized with sodium sulfite, concentrated to 3 l., dialyzed against running water, and poured into ethanol (9 l.). The precipitate was isolated and dried, to give 15 g. of a light brown powder. Chromatography of an acid hydrolyzate of this material (product B) indicated the presence of the same sugars as those given by product A.

Isolation of Alkali-Extractable Polysaccharides. The holocellulose (205 g.) was extracted by stirring it for 24 hr. at room temperature with aqueous (5% w/v) sodium hydroxide (6 l.). The mixture was then filtered, and the filtrate was neutralized with acetic acid, dialyzed against running water, concentrated to 3 l., and poured into ethanol (10 l.). The precipitate was isolated and dried to yield 18 g. of a near-white product (product C). The residual fiber was next extracted in the same way with 10% w/v aqueous sodium hydroxide, to yield product D (9 g.), followed by 18% w/v aqueous sodium hydroxide, to yield product E (5 g.). Chromatography of acid hydrolyzates of products C, D, and E indicated, in each case, the presence of galactose, glucose, mannose, arabinose, xylose, and traces of 4-*O*-methylglucuronic acid. Products C and D also gave traces of galacturonic acid, rhamnose, and other unidentified sugars. The residual alpha-cellulose was washed with 2 *N* acetic acid until the washings were acidic, then with water until the washings were neutral, then with ethanol, and airdried. The yield was 156 g. An acid hydrolyzate contained traces of mannose in addition to glucose. Table I indicates the relative intensities of the major spots observed on the treated chromatograms of the various hydrolyzates.

Products C, D, and E were combined and dissolved in *N* sodium hydroxide (2 l.). Fehling's solution (A:B:2:1 v/v) was added dropwise with stirring until no further precipitation occurred. The precipitate was collected (centrifuge), washed with water, and dissolved in 2 *N* acetic acid (1 l.). The solution was poured into ethanol (3 l.); the precipitate was collected, washed until copper free with acidified acetone, then with pure acetone, and airdried. The product (F) weighed 23.5 g., and on hydrolysis yielded galactose, glucose, mannose, and xylose, together with traces of arabinose and 4-*O*-methylglucuronic acid (chromatographic detection). After collection of the copper complex of product F, an equal volume of ethanol was added to the supernatant solution, whereupon another copper complex was precipitated. From it was recovered, in the same way as for F, a product G (5.5 g.) which upon acid hydrolysis yielded galactose, glucose, arabinose, and traces of rhamnose and other unidentified sugars. The remaining supernatant solution was neutralized with acetic acid, concentrated to 2 l., dialyzed against running water, concentrated again

(to 1 l.), and poured into acetone (5 l.). The precipitate (product H; 3 g.) was recovered, and hydrolyzed with pectinase. Chromatography of the products indicated the presence of galacturonic acid, and smaller amounts of galactose, glucose, and arabinose.

Isolation of a Galactan. Product A (15 g.), in water (1.5 l.) was treated with α-amylase (2 g.) at 75°C. for 15 min., after which time the solution was no longer stained blue by iodine. The mixture was poured into ethanol (3 l.). The precipitate was collected, washed with 80% v/v aqueous ethanol, then with acetone, and airdried. The yield was 9.5 g. This precipitate, upon acid hydrolysis, yielded galactose and arabinose in the approximate ratio 3:2, together with traces of rhamnose and other unidentified sugars, as the only products detectable by paper chromatography. The precipitate was dissolved in 0.5 *M* boric acid (500 ml.), and 0.1 *N* cetyltrimethylammonium hydroxide (100 ml.) was added, whereupon the solution became cloudy. *N* sodium hydroxide was added dropwise with stirring until the particles aggregated; the precipitate was collected, dissolved in 2 *N* acetic acid (200 ml.), and the solution was poured into ethanol (1 l.). The precipitated product was collected and refractionated twice more in the same way. The final yield was 3.5 g. This material had $[\alpha]_D$ −22°, and contained residues of galactose and arabinose in the approximate ratio 10:1. When more sodium hydroxide was added to the supernatant solution, a second precipitate was obtained, and the product recovered from it was found to be enriched in arabinose residues.

The galactan was methylated, first with methyl sulfate and sodium hydroxide, then with Kuhn's reagents (*36*), and finally with Purdie's reagents. The product (2.5 g.) was dissolved in chloroform (100 ml.), and ligroin (700 ml.) was added. The precipitate was isolated by decantation of the supernatant solution. When a portion of this precipitate was boiled with 6 *N* hydrochloric acid, no furfuraldehyde was liberated, as judged by the effect of the vapor on filter paper moistened with aqueous aniline acetate. After demethylation and hydrolysis of a portion with hydrobromic acid (*32*), galactose was the only product detectable by chromatography. The methylated galactan was hydrolyzed with formic acid (*37*); the products were examined by chromatography in solvent (*c*), and estimated by iodometric titration. They were found to be chromatographically indistinguishable from the following sugars, and to be present, approximately, in the proportions indicated: (i) 2,3,4,6-tetra-*O*-methyl-D-galactose (6 parts), (ii) either 2,3,4- or 2,4,6-tri-*O*-methyl-D-galactose (6 parts), or both, (iii) 2,3,6-tri-*O*-methyl-D-galactose (2 parts), (iv) 2,4-di-*O*-methyl-D-galactose (3 parts), and (v) mono-*O*-methyl-galactose(s) (1 part).

Isolation of an Araban. Product G (5.5 g.) was treated with α-amylase as previously described, and the enzyme-resistant polysaccharides (3 g.) were isolated and dissolved in 0.5 *M* boric acid (150 ml.). Upon addition of 0.1 *N* cetyltrimethylammonium hydroxide (20 ml.), the solution became faintly cloudy, and subsequent dropwise addition of *N* sodium hydroxide caused deposition of a small precipitate, which was removed by filtration. Addition of more *N* sodium hydroxide to the filtrate then gave a precipitate from which a polysaccharide fraction (1 g.) was recovered in the same way as for the galactan. From the supernatant solution, the remaining material (*ca.* 1.5 g.) was recovered; this had $[\alpha]_D$ −70°, and upon hydrolysis yielded arabinose and galactose in the ratio 12:1.

Examination of the Mannan and Xylan Components

Product F (10 g.) was dissolved in water (1 l.) containing takadiastase (2 g.), and the solution was kept at 37°C. under toluene. At daily intervals, aliquots were withdrawn and spotted on chromatograms. For the first 8 days, glucose and oligosaccharides were the only products detectable by chromatography, after which traces of xylose and arabinose were also detected. At this stage, the reaction mixture was poured into ethanol (3 l.), and the precipitated polysaccharides (6 g.) were recovered, and methylated as previously described. The methylated product (4.5 g.) was dissolved in chloroform (200 ml.), and ligroin (400 ml.) was added. The precipitate (fraction 1, 1.5 g.) was collected. Addition of more ligroin (300 ml.) to the supernatant solution then gave a second precipitate (fraction 2, 1.8 g.), and the remaining supernatant solution was evaporated to give fraction 3, 1 g.

A portion of fraction 3, when boiled with 6 *N* hydrochloric acid, liberated no furfuraldehyde (aniline acetate test), and a sample demethylated and hydrolyzed with hydrobromic acid (*32*) was found by chromatography to give mannose and a trace of glucose only. The methylated mannan was hydrolyzed with formic acid (*37*), and the products were separated by preparative paper chromatography in solvent (*c*) into five components. These compounds were identified as the following, and the proportions indicated were determined approximately, by weighing the samples after isolation: (i) 2,3,4,6-tetra-*O*-methyl-D-mannose (1 part) (ii) 2,3,4,6-tetra-*O*-methyl-D-galactose (2 parts), (iii) 2,3,6-tri-*O*-methyl-D-mannose (35 parts), (iv) 2,3,6-tri-*O*-methyl-D-glucose (7 parts), and (v) di-*O*-methyl-hexoses (3 parts). Compounds (i) to (iv) inclusive were identified as crystalline derivatives, in the manner described in a previous publication (*37*).

A portion of fraction 1, on demethylation and hydrolysis, gave xylose as the only component detectable by chromatography. On hydrolysis, it yielded three components as the only significant products detectable on chromatograms. Iodometric titration indicated that these were present in the approximate ratio 35:1:1. The major component was chromatographically indistinguishable from 2,3-di-*O*-methyl-D-xylose, and when isolated and seeded with this compound, it crystallized, and had m.p. and mixed m.p. 78°C. The other two components were chromatographically indistinguishable from 2,3,4-tri-*O*-methyl-D-xylose, and 2,3,5-tri-*O*-methyl-L-arabinose, respectively. The former, after boiling with ethanolic aniline, afforded crystals; they had m.p. 100°C., unchanged on admixture with 2,3,4-di-*O*-methyl-*N*-phenyl-D-xylosylamine.

DISCUSSION OF RESULTS

The foregoing results indicate that the noncellulosic polysaccharides in the inner bark of white spruce may be classified into three major groups. One of these is starch, which may be present largely, if not completely in the form of granules. This starch is similar to starch

from other sources inasmuch as it gives a deep blue color with iodine, has a high positive specific rotation, and is degraded by α-amylase at a rate similar to that of potato starch.

In view of the results of histological (*22*) and histochemical (*23*) work on other barks, there seems to be little doubt that these starch granules originate from the parenchyma, and constitute food-reserve material for the tree. Since the bark for this work was cut in the autumn, it is probable that its starch content was at a maximum.

It is interesting to note that not all of the starch was extracted by the aqueous buffer at 70°C; further quantities were liberated during bleaching of the fiber with chlorous acid, and still further amounts were removed during subsequent extraction of the holocellulose with aqueous alkali. Hence, some of the starch was relatively inaccessible to extraction, and if present as granules, these must have been subject to a rather high degree of physical protection. In an elegant histochemical study of slash pine bark, Lyness and Opdyke (*23*) have shown that, in the inner bark, the tannins are confined almost exclusively to discrete bodies inside the parenchyma cells, where they surround clusters of starch granules. If the same is true for white spruce, it is probable that much of the tannins would be physically protected, in the same way as the starch granules; this circumstance may account in part for their resistance to extraction by organic solvents in the present work.

The second group of polysaccharides is represented by that material which can be extracted, together with starch, by hot aqueous buffer at pH 7, although essentially similar material also appeared in the chlorite liquor and in the alkaline extracts. This behavior indicates that, relative to those polysaccharides which appeared *exclusively* in the alkaline extracts, this group is quite accessible to extraction. As such, these polysaccharides may be largely, albeit not necessarily completely, extracellular (i.e., intercellular) in origin. As chemical and histochemical studies have shown (*23*), there is very little true lignin (i.e., methoxyl-containing material) in the inner bark and secondary phloem of slash pine. The inner bark, therefore, presents a striking contrast with the sapwood, in which the intercellular material becomes heavily lignified as the cells mature.

With the chemical and electrophoretic separations used in the present work, three distinct fractions could be isolated from the second group of polysaccharides, which had as their major structural units galacturonic acid, galactose, and arabinose residues, respectively. Since the fraction consisting mainly of galacturonic acid residues could be largely extracted at pH 7, it is possible that, in the native state, it was extensively esterified, either with methanol or with other carbohydrates, rather than being present as its calcium salt. This fact, together with its high positive specific rotation, and its ready susceptibility to pectinase, probably justifies classification of this fraction as "pectinic acid."

The fraction consisting mainly of galactose residues is particularly interesting, since examination of the methylated "galactan" indicated that most of the molecules therein were highly branched. It is quite possible that most of this fraction was originally very similar to the water-soluble arabogalactan of white spruce wood (*38*), arabinofuranosyl end-groups having been removed during bleaching with chlorous acid. Although information concerning the galactans which are normally associated with pectic material is very sparse, the available evidence is that these are of the linear, $\beta = (1 \rightarrow 4)$ linked type (*39*). The tentative (chromatographic) identification of 2,3,6-tri-*O*-methylgalactose in the hydrolyzate of the methylated "galactan" in the present work suggests that a small amount of such a galactan may indeed be present in the bark, in addition to a different, highly branched galactan or arabogalactan.

The fraction consisting mainly of arabinose residues has not yet been examined with respect to its structural features, but its specific rotation (−70° in water) suggests that it may be composed largely of α-L-arabinose residues, some of which may be in the furanose form. The highly branched araban of peanut pectin (*39*) has $[\alpha]_D$ −160°, and the araban from sugar-beet pectin has $[\alpha]_D$ −103° (*40*). It is possible that the present araban is similar to other pectic arabans (*39*, *40*), its numerically lower levorotation arising from the cleavage of α-L-arabinofuranosyl groups during bleaching with chlorous acid.

The third group of polysaccharides in the inner bark includes those which appear exclusively in the alkaline extracts, namely, those containing xylose and mannose residues. The well-known fact that cellulosic fibers are swollen by alkali, and thus rendered more accessible, suggests that these polysaccharides were closely associated with the cellulose in the cell-walls, and hence they represent true hemicellulosic material. Fractionation of these hemicelluloses, which accumulated in the copper-complexing fraction (F), has shown that the mannose and xylose residues are present in separate polysaccharides.

If the possible presence of hexofuranose residues is ignored, the methylation results indicate that the mannose-containing polymers consist of essentially linear chains, in which D-mannopyranose residues are linked through positions 1 and 4, probably in the β-configuration. Similarly linked D-glucose residues were also present in the fraction studied, and it seems probable that the bark contains heteropolymer glucomannans, which are similar to those of wood. It is probable that the galactose residues in fraction (F) arose mainly from contamination by the galactan previously described, since the proportion of them in the methylated mannan was much lower than in the original material. Their appearance in the electrophoretically separated mannan could likewise be explained by the fact that the galactan and the mannan had very similar electrophoretic mobilities.

The nature of the hydrolysis products of the methylated xylan fraction again indicated a general similarity between the xylans of the inner bark and other hemicellulosic xylans, although the proportion of 4-*O*-methylglucuronic acid residues in fraction (F) was remarkably low, and no uronic acid could be detected in the methylated xylan. The arabinose residues in the xylan fraction may have been chemically linked to xylan chains, or they may have arisen from contaminating araban.

The most remarkable feature of the hemicellulosic

fraction (F) was its high content of glucose residues, and the fact that it gave a brown color with aqueous iodine at room temperature. This glucose-containing material was completely insensitive to α-amylase, and was digested only very slowly by a strong solution of takadiastase. It was electrophoretically distinct from the mannose-containing polysaccharides, which were associated with only minor amounts of glucose residues, but it could not be separated from the xylan electrophoretically, or by fractional precipitation, or in the ultracentrifuge.

With the available evidence, therefore, the possibility cannot be excluded that, in the inner bark, glucose and xylose residues are chemically linked together in heteropolymeric glucoxylans. However, if this is the case, the two types of sugar residue must be very unevenly distributed in the polymer, since takadiastase cleaved most of the glucose residues selectively, without causing extensive degradation of the xylan. It seems more probable that a separate glucan is present, which is substantially different from "normal" starch.

Possibly, this glucan was merely starch which had been degraded during treatment with chlorous acid and alkali, and had been structurally modified in such a way that it was no longer susceptible to α-amylase. However, if this is true, it is difficult to understand why the degraded starch should have accumulated in the copper-complexing fraction (F), whereas the remaining, less-degraded starch would not form an insoluble copper complex under the same conditions.

It is well known, from the classical researches of O'Dwyer (*41*), Anderson and co-workers (*42*, *43*), and Campbell (*24*), that the sapwoods of some deciduous trees contain starchlike glucans which are only slowly digested by diastatic enzymes. These workers tended to conclude that xylose, glucose, and hexuronic acid residues were chemically combined in the same polysaccharide, and they were attracted by the hypothesis that such materials represented intermediates in the biological conversion of hexosans into pentosans. While such views still deserve serious consideration, it is known that, in some cereal grains, "normal" starch is accompanied by separate arabinoxylans, and other glucans (*44*), and it is not unreasonable to suppose that the food-reserve systems of woody plants involve a similar group of polysaccharides.

These preliminary investigations represent an attempt to overcome some of the technical difficulties which are peculiar to the study of bark polysaccharides, and to present a simple system for their classification, somewhat similar to that which has developed for wood. While such a system is rather arbitrary in nature, it is hoped that it will serve as a basis for future investigations on the polysaccharides of bark.

It is already clear that many barks are rich in gums and pectins, for which some industrial use may eventually be found. Furthermore, it is to be expected that fundamental studies on bark polysaccharides will lead to a much better understanding of the processes taking place in the living tree. As long ago as 1947, Anderson and Pigman (*9*) stressed the importance of studying the living part of the tree, namely, the inner bark, the cambial zone, and the sapwood, and their opinion is no less valid today.

LITERATURE CITED

1. Schwalbe, C. G.. and Neumann, K. E., *Cellulosechem.* 11: 113 (1930).
2. Buston, H. W. and Hopf, H. S., *Biochem. J.* 32: 44 (1938).
3. Cram, K. H., Eastwood J. A., King, F. W., and Schwartz, H., *Dominion Forest Service Circular* No. 62, 1947 (Canada); *Chem. Abstr.* 41: 4643 (1947).
4. Chang, Y. P.. and Mitchell, R. L., *Tappi* 38: 315 (1955).
5. Hay, K. D.. and Lewis, H. F., *Paper Trade J.* 111, 25: 39 (Dec. 19, 1940).
6. Sharkov, V. I., Tyagunova, Z. A., and Kolpina, V. N., *Lesokhim. Prom.* 6, No. 2: 9 (1938); *Khim Referat Zhur.* 2, No. 3: 123 (1939); *Chem. Abstr.* 34: 1050 (1940).
7. Sharkov, V. I., Girchits, A., and Sartaniya, F. A., *Lesokhim. Prom.* No. 3: 40 (1939); *Khim. Referat Zhur.* No. 8: 113 (1939); *Chem. Abstr.* 34: 5273 (1940).
8. Sharkov, V. I. and Girchits, A., *Lesokhim. Prom.* No. 2: 9 (1939), *Khim Referat Zhur.* No. 9: 113 (1939); *Chem. Abstr.* 34: 6324 (1940).
9. Anderson, E. and Pigman, W. W., *Science* 105: 601 (1947).
10. Anderson, E., Wise, L. E., and Ratliff, E. K., *Tappi* 37: 422 (1954).
11. Pigman, W. W., Anderson, E., and Leaf, R. L., *J. Am. Chem. Soc.* 70: 432 (1948).
12. Kotásek, Z., *Veda a výzkum v průmyslu Kožedělném* 1: 47 (1956); *Chem. Abstr.* 51: 12525 (1957).
13. Jones, J. K. N. and Smith, F., *Advances in Carbohydrate Chemistry* 4: 243 (1949).
14. Anderson, E., *J. Biol. Chem.* 104: 163 (1933).
15. Gill, R. E., Hirst, E. L., and Jones, J. K. N., *J. Chem. Soc.* 1469 (1939).
16. Gill, R. E., Hirst, E. L., and Jones, J. K. N., *J. Chem. Soc.* 1025 (1946).
17. Hough, L., Jones, J. K. N., and Hirst, E. L., *Nature* 165: 34 (1950).
18. Öiseth, D., *Pharm. Acta. Helv.* 29: 251 (1954); *Chem. Abstr.* 49: 3316 (1955).
19. Erskine, A. J. and Jones, J. K. N., *Can. J. Chem.* 34: 821 (1956).
20. Becker, E. S. and Kurth, E. F., *Tappi* 41: 380 (1958).
21. Larsen, E. E. and Lynn, E. V., *J. Am. Pharm. Assoc.* 26: 288 (1937); *Chem. Abstr.* 31: 4451 (1937).
22. Chang, Y. P., Tappi Monograph No. 14 (1954).
23. Lyness, W. I. and Opdyke, D. L., Paper presented at 133rd Meeting of the American Chemical Society, San Francisco, April, 1958; also personal communication.
24. Campbell, W. G., *Biochem. J.* 29: 1068 (1935); *Nature* 136: 299 (1935).
25. Zienius, R. H. and Purves, C. B., *Tappi* 43: 27 (1960).
26. Bryce, J. R. G., Ph.D. Thesis, McGill University, 1955.
27. Sanderson, E. S., Ph.D. Thesis, McGill University, 1953.
28. Bourne, E. J., Foster, A. B., and Grant, P. M., *J. Chem. Soc.* 4311 (1956).
29. Barker, S. A., Stacey, M., and Zweifel, G., *Chem. & Ind.* 332 (1957).
30. Bouveng, H. O., and Lindberg, B., *Acta Chem. Scand.* 12: 1977 (1958).
31. Meier, H., *Acta Chem. Scand.* 12: 144 (1958).
32. Hough, L., Jones, J. K. N., and Wadman, W. H., *J. Chem. Soc.* 1702 (1950).
33. Metzenberg, R. L. and Mitchell, H. K., *J. Am. Chem. Soc.* 76: 4187 (1954).
34. Hirst, E. L. and Jones, J. K. N., *J. Chem. Soc.* 1659 (1949).
35. Hough, L., Hirst, E. L., and Jones, J. K. N., *J. Chem. Soc.* 928 (1949).
36. Kuhn, R., Trischmann, H., and Löw, I., *Angew. Chem.* 67: 32 (1955).
37. Jones, J. K. N. and Painter, T. J., *J. Chem. Soc.* 573 (1959).
38. Adams, G. A., *Can. J. Chem.* 36: 755 (1958).
39. Hirst, E. L. and Jones, J. K. N., *Advances in Carbohydrate Chemistry* 2: 235 (1946).
40. Andrews, P., Hough, L., Powell, D. B., and Woods, B. M., *J. Chem. Soc.* 774 (1959).
41. O'Dwyer, M. H., *Biochem. J.* 28: 2116 (1934); 33: 713 (1939); 34: 149 (1940).
42. Anderson, E., Seeley, M., Stewart, W. T., Redd, J. C., and Westerbeke, D., *J. Biol. Chem.* 135: 189 (1940).
43. Anderson, E., Kaster, R. B., and Seeley, M., *J. Biol. Chem.* 144: 767 (1942).
44. Aspinall, G. O., *Advances in Carbohydrate Chemistry* 14: 441 (1959).

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ASSOCIATION NEWS AND EVENTS

National Conferences

1960

Fourteenth Alkaline Pulping Conference, Aug. 22–24, 1960, Multnomah Hotel, Portland, Ore.

Forest Biology Conference, Aug. 24–27, 1960, New Washington Hotel, Seattle, Wash.

Eleventh Testing Conference, Sept. 27–29, 1960, Pantlind Hotel, Grand Rapids, Mich.

Fifth Deinking Conference, Oct. 5–7, 1960, Conway Hotel, Appleton, Wis.

Tenth Corrugated Containers Conference, Oct. 10–13, 1960, Royal York Hotel, Toronto, Ont.

Fifteenth Plastic Plastics-Paper Conference, Oct. 17–19, 1960, Syracuse Hotel, Syracuse, N. Y.

Fifteenth Engineering Conference, Oct. 24–28, 1960, Robert Meyer Hotel, Jacksonville, Fla.

Fundamental Research Conference, Nov. 3–5, 1960, Northampton Hotel, Northampton, Mass.

1961

46th Annual Meeting, Feb. 19–23, 1961, Commodore Hotel, New York, N. Y.

Twelfth Coating Conference, May 22–24, 1961, Statler-Hilton Hotel, Buffalo, N. Y.

Twelfth Testing Conference, Aug. 15–18, 1961, Queen Elizabeth Hotel, Montreal, Que.

Eleventh Corrugated Containers Conference, Sept. 11–13, 1961, St. Francis Hotel, San Francisco, Calif.

Fourth Mechanical Pulping Conference, Sept. 19–21, 1961, Edgewater Beach Hotel, Chicago, Ill.

Symposium on Formation and Structure of Paper, Sept. 25–29, 1961, B.P.B.M.A., Oxford, England.

Sixteenth Plastics-Paper Conference, Oct. 9–11, 1961, French Lick Sheraton Hotel, French Lick, Ind.

Sixteenth Engineering Conference, Oct. 15–19, 1961, Shoreham Hotel, Washington, D. C.

Fifteenth Alkaline Pulping Conference, Nov. 1–3, 1961, Rice Hotel, Houston, Tex.

1962

47th Annual Meeting, Feb. 18–22, 1962, Commodore Hotel, New York, N. Y.

Thirteenth Coating Conference, May 14–16, 1962, Netherland-Hilton Hotel, Cincinnati, Ohio.

Thirteenth Testing Conference, Sept. 18–20, 1962, Benjamin Franklin Hotel, Philadelphia, Pa.

Seventeenth Engineering Conference, Oct. 14–19, 1962, Queen Elizabeth Hotel, Montreal, Que.

Twelfth Corrugated Containers Conference, Oct. 23–26, 1962, Statler-Hilton Hotel, Boston, Mass.

Sixteenth Alkaline Pulping Conference, 1962, Savannah, Ga.

1963

Fourteenth Coating Conference, May 19–22, 1963, French Lick Sheraton Hotel, French Lick, Ind.

Thirteenth Corrugated Containers Conference, Oct. 22–25, 1963, Statler-Hilton Hotel, Detroit, Mich.

Eighteenth Engineering Conference, 1963, Chicago, Ill.

Study Group of European TAPPI Members Meeting, 1960

The Sixth Annual Congress of the Study Group of European TAPPI Members will be held in Lucerne, Switzerland, Sept. 12–17, 1960. The following programs have been arranged.

SUNDAY, SEPT. 11, 1960
MONDAY, SEPT. 12, 1960

15.00–20.00 / 08.00–10.00 Registration at Travel-Bureau Bucher & Co., Inc., Haldenstrasse 4, Lucerne

MONDAY, SEPT. 12, 1960

11.00 Opening of Conference Office at the Congress-House

MONDAY, SEPT. 12, 1960

10.00–12.30 / 14.30–17.30 Technical Program at the Congress-House

18.30–20.00 Reception offered by Escher-Wyss, Ltd., Ravensburg, at the Hotel National, Haldenstrasse 4, Lucerne

TUESDAY, SEPT. 13, 1960

09.00–12.30 / 14.30–17.30 Panel discussion on education for papermaking in Europe at the Congress-House

18.30–20.00 Reception offered by Sulzer Brothers, Ltd., Winterthur, at the Hotel Union, Löwenstrasse 16, Lucerne

WEDNESDAY, SEPT. 14, 1960

09.00–12.30 Technical Program at the Congress-House

14.30 General Meeting at the Congress-House (TAPPI members only)

20.00 Dinner at the Hotel Schweizerhof, Schweizerhofquai, Lucerne

THURSDAY, SEPT. 15, 1960

08.00 Departure by coach from the different hotels for the visit of

Group A:
- The Attisholz Sulfite Pulp Mill (in the forenoon)
- The Utzenstorf Paper Mills (newsprint and mechanical printing, in the afternoon)

Group B:
- The Attisholz Sulfite Pulp Mill (in the forenoon)
- The Deisswil Paper & Board Mill (in the afternoon)
- Luncheon: Offered by the Attisholz Sulfite Pulp Mill at Bad Attisholz

FRIDAY, SEPT. 16, 1960

09.00 Departure from the different hotels for a visit to Cham Paper Mills

After the visit, Luncheon at the Casino in Zug, offered by the Cham Paper Mills

TENTATIVE TECHNICAL PROGRAM

MONDAY, SEPT. 12, 1960

10.00–12.30 "High-Speed Cinematography in the Pulp Industry," by Prof. P. Willems, Switzerland

"Problems of High-Speed Machines," T. Brossard, Switzerland
"Recent Developments in Pumps, Turbines, etc.," by Sulzer Brothers, Switzerland

14.30–17.30 "High-Speed Camera Movies Showing Some Phenomena Occurring in the Formation of a Sheet," talk & film by G. Cocomero & A. Restagno, Italy
"The Influence of Mannogalactan Gums on Formation," B. Iversson, Sweden
"Increased Drying Capacity with Forced Convection—Principles and Problems Involved," M. D. Jepson, Great Britain
"Instrumentation," Discussion led by Wiggins, Teape & Co., Ltd., Great Britain

TUESDAY, SEPT. 13, 1960

09.00–12.30 "Education for Papermaking in Europe." Panel of Educationalists: Prof. W. Brecht, Germany; Prof. K. Adamik, Austria; Prof. P. Chene, France; Prof. G. Centola, Italy; F. L. Hudson, Great Britain; and one other. Panel of Industrialists: V. Bunzl, Austria; K. Scheufelen, Germany; and others.

14.30–17.30 "How to Introduce the Educated Man into the Pulp and Paper Industry and Get the Best Use of His Abilities." Discussion led by Dr. H. F. Rance, Great Britain
"The Efficient Utilization of Research Ideas in the Practical Field." Discussion leader yet to be named.

WEDNESDAY, SEPT. 14, 1960

09.00–12.30 "High Yield Sulfite Pulping," by R. Borisek, Czechoslovakia
"Sulfite Pulping—A Survey." Speaker yet to be named
"The Yellowing of Sulfite Pulp," by M. Monzie, France

14.30 General Meeting for TAPPI Members only

Hotel arrangements are to be made through Travel-Bureau Bucher & Co., Ltd., Haldenstrasse 4, Lucerne, Switzerland.

Association Constitution Amended

Two proposed amendments to the Constitution have received the final approval of the voting members of the Association. Both proposals had been unanimously approved at the 1960 Annual Meeting in February and were submitted to the voting members for final ratification by letter ballot.

By a vote of 1486 to 47 the "overseas member" class of membership is to be eliminated, so that all TAPPI members will be classified on the basis of their technical qualifications, rather than partly on the basis of geography. This will extend to properly qualified individuals outside of North America the same voting and office-holding privileges presently offered to active members in North America. Furthermore, it will enable the Association to accept student members from other continents in addition to those from North American countries.

Corresponding changes will now have to be made in the Association Bylaws before the new membership structure can be officially established. Such amendments to the Bylaws will be submitted to the Executive Committee for consideration at its September meeting.

Additional information on membership classification is given in the "TAPPI Notes" of this issue.

The second amendment which has been approved is to change the title of "Secretary" to "Executive Secretary." This proposed amendment has been ratified by a vote of 1490 to 40.

The Executive Committee and officers wish to express their gratitude for the interest and support demonstrated by the active members who participated in the balloting.

Printability Proceedings

The proceedings of the Third Symposium on Printability of Paper, held by EUCEPA in Paris in October, 1959, have been published in limited quantity, and may be ordered from EUCEPA, 154 Boulevard Haussmann, Paris 8, France, at 60 new francs per copy.

Included in the 420-page cloth-bound book are the 20 papers and discussions comprising the symposium. Each paper is in its original language (English, French, or German) and a résumé of each is given in all three languages.

Fifth Deinking Conference

The tentative program for the Fifth Deinking Conference to be held at the Conway Hotel in Appleton, Wis., Oct. 6–7, 1960, is:

General Theme—Deinking Today and Tomorrow

October 6—Economics of Deinking
Morning Session
1. Waste Paper Supply
2. Cost of Deinking
3. Economics of Deinked Stock Usage versus Virgin Pulp Usage
4. Economics of Recovering in the Deinking System

Afternoon—Mill Tour, Bergstrom Paper Co., Neenah, Wis.
Evening—Banquet

October 7—The Future of Deinking
Morning Session
1. Factors Tending to Increase Deinking Problems
2. Practical Approaches to Solving Deinking Problems
3. What Can Basic Research Do
4. Growth in the Waste Paper Market

Afternoon—Tour of the Institute of Paper Chemistry, Appleton, Wis.

J. D. Allen, Bergstrom Paper Co., Neenah, Wis. is general conference chairman, R. Kinne of Sealrigth, Oswego Falls Corp., Fulton, N. Y., is technical program chairman, and George C. Sisler of Bergstrom Paper Co., Neenah, Wis., is mill tour chairman.

Tenth Corrugated Containers Conference

North America's fastest growing city—Toronto, Ont.—is the well chosen location for the four-day tenth Corrugated Containers Conference which starts on Oct. 10, 1960. This is the first time this conference has been held in Canada. It is jointly sponsored by Technical Association of the Pulp and Paper Industry and the Technical Section, Canadian Pulp and Paper Association. The conference will be held in the 1600 room Royal York Hotel.

In the days of the early settlers, what is now Toronto was the southern end of an Indian trail that linked Lakes Huron and Ontario. Appropriately, the name "Toronto" is of Huron origin. It has two possible meanings: either "place of meeting" or "plenty."

At the time of the rivalry between the French and the British in 1750, the French established a fort in the area which was called Fort Rouille but commonly known as Fort Toronto. To save it from falling into the hands of the British it was destroyed by fire in 1759 during the Seven Years War.

In 1788 the British undertook a more ambitious plan and had a large part of the territory surveyed. A residential area with military buildings in the center was designed by a Captain Mann who called the town-to-be "Toronto." Soon

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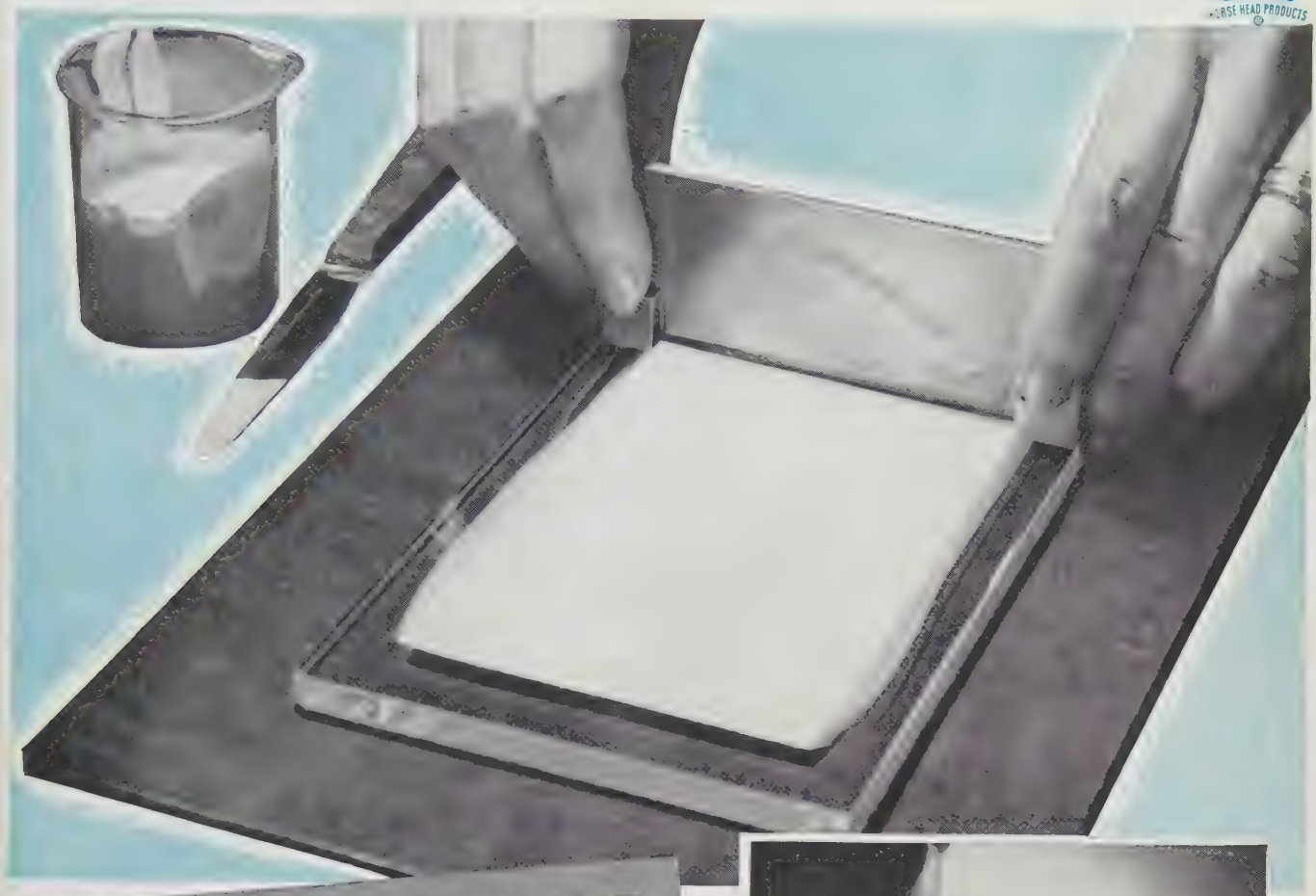

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after, the United Empire Loyalists moved into what was then known as Upper Canada, with many settling in and around Toronto. Most of these people had been born in the United States and had fought on the side of the British.

Lieut.-Col. John Graves Simcoe, the first Lieutenant Governor of Upper Canada, temporarily established the capital at Toronto from which it has never moved. In honor of one of the sons of King George III he changed the name to "York."

By the time the War of 1812 began, Toronto was a thriving community. Then the Americans marched in, destroyed Fort York (which the British had built to replace the older French fort), the legislative buildings, the archives, and carried off the Mace.

This was the incident that touched off the British attack on Washington. In reprisal the British burned all the public buildings, too, and Scottish troops sat down to a dinner that had been prepared for the President! Then they burned the President's mansion. This was later restored and became known as the White House because so many coats of white paint were needed to cover up the scars of the fire.

Though the feelings of the outraged British were somewhat relieved, they never recovered the Mace, and it was not until 1934 that President Franklin D. Roosevelt returned it to Toronto.

In 1834 the Government of Upper Canada extended the limits of the town of York and incorporated it into a city changing its name back again to Toronto.

Toronto's first municipal elections were held in March, 1834. The first mayor was colorful William Lyon Mackenzie, the grandfather, on his mother's side, of the late Prime Minister of Canada, William Lyon Mackenzie King.

Today greater Toronto is fast approaching the 2 million population mark. It is not only the hub of the Canadian industrial and financial world but it also heads the Great Lakes system for overseas export-import shipments. It is almost impossible to list the many attractions Toronto has to offer. Some of these could include the art gallery, museum, transportation system, T. V. studios, theaters, Canadian National Exhibition, Royal Canadian Yacht Club, race tracks and many civic sport centers—to mention only a few.

To take full advantage of this outstanding convention city, a special program has been organized for the ladies attending the Corrugated Containers Conference. Starting on Sunday, October 9, a hospitality room will be maintained in the British Columbia Room where ladies may get together and where at all times they can obtain information about Toronto and surrounding area. This same room will be used for the ladies' continental breakfast during each of the four days of the conference.

The film "Designed to Go Places" will be shown on Monday afternoon followed by a reception given by the machinery manufacturers.

After breakfast on Tuesday the ladies will be taken on a conducted bus tour of the city with lunch at the world famous Casa Loma. This 3 million dollar massive 98 room palace has 15 telephone-equipped bathrooms and 23 open fireplaces (each imported from a famous dwelling in Europe). In addition to its turrets and underground dungeons it also has an 1800 bottle wine cellar, secret panels, and even white-tiled mahogany-fitted stables.

On Tuesday evening delegates and their wives will be guests of the Canadian corrugated container companies at a reception.

A bus trip to and around Niagara Falls and luncheon there will be the main feature of the ladies' program for Wednesday and on Thrusday the day has been left open for shopping.

While the ladies are seeing the sights, the men will be busy at their various sessions. The first day of the conference, Monday, October 10th, is taken up with committee meetings. The next two days will be occupied with the presentation of papers and discussions and on the final day there will be a tour of three of Canada's converting plants in the Toronto area.

The conference is open to all who are interested in corrugated containers regardless of whether they are members of TAPPI or Technical Section, CPPA. Reservations at the Royal York Hotel, Toronto, Ont., should be made as soon as possible.

Second Annual Packaging, Plant Layout, and Material Handling Short Course

Representatives of the military will appear on the program. L. C. Heller, chief, Packaging Section, Office of Naval Material, Washington, D. C., will discuss "Loss and Damage Prevention." Lt. Col. George A. Davies, chief, Packaging Branch, Directorate of Transportation, Department of the Air Force, Washington, D. C., will cover the topic "Cost Reduction and Cost Factoring in Packaging." Professor Mart I. Fowler of Purdue University will participate, and Kenneth Brown of UCLA Engineering Extension Staff is short course coordinator and program director of packaging. W. B. Semco, well-known Los Angeles consulting engineer, is program director of plant layout and material handling.

Additional information regarding the program is available from Engineering Extension, Room 6266 G, Engineering Building, Unit 11, University of California, Los Angeles 24, Calif.

1960 Summer Meeting, Technical Section Canadian Pulp and Paper Association

Banff Springs Hotel, Banff, Alb., will be the scene of the 1960 Summer Meeting of the Technical Section, Canadian Pulp and Paper Association, to be held Sept. 6–9, 1960.

A theme has been chosen for this meeting entitled "Towards the more complete and efficient utilization of our raw materials and manpower resources," making it differ somewhat from meetings of the past. Sessions are being prepared to fit in with this theme and there will not be more than one session held at a time. In addition, a visiting delegation from the British Technical Section will be present.

The program has not been finalized, but the following is a list of tentative topics for presentation.

More Efficient Use of Our Water Resources
Better Materials Handling Methods Resulting in Better Use of our Resources with Case Histories of Cost Reductions
A New High Velocity Hood Installation
Automation in the Woodroom
The More Efficient Use of Fuel—by National Industrial Fuel Efficiency Service on Their Findings in England and in Canada
Groundwood Stock Evaluation as Viewed from Its Effect on Paper Machine Operation
The Use of Engineering Models in Design
Efficient Pressing Based on Analysis of 120 Drier Sections
Factors Involved in Sizing Fibrous Products
Bark Utilization
Radical Drying Techniques for the Industry
The Reason for and Function of Chemical Pulp in a Newsprint Furnish
The Installation of the World's Largest Reinforced Plastic Pipe
The Use of Wood Rejects in the Manufacture of Roofing Felt
The Measurement of Fiber Flexibility (by title)
Pulpwood Subdivision without Compression Damage—The Development of a New Chipping Method
Storage Bin Design for the Flat-Type Chip

Contributions from the British Delegation

Towards Greater Objectivity
A Forced Convection Hood Applied to the Dry Part of Paper and Boardmaking Machines
The Use of Manpower in Research
The More Efficient Use of Starch in Papermaking

The dinner speaker on Thursday, September 8, will be M. J. Foley, president, MacMillan, Bloedel and Powell River, Ltd.

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Delegates who plan to attend the Summer Meeting should bear in mind that the meeting follows directly after Labor Day Week End. In view of this, it is suggested that travel reservations be made as early as possible.

As has been the policy at previous meetings, the Technical Section will welcome nonmembers who wish to attend the Summer Meeting.

Please note that the Technical Section is unable to handle requests for accommodation. All reservations should be made through D. A. Williams, Manager, Banff Springs Hotel, Banff, Alb.

The Second Annual Packaging, Plant Layout, and Material Handling Short Course will be presented by the University of California, Los Angeles, at the UCLA Conference Center, Lake Arrowhead, Calif. The dates of the Short Course are Sept. 25–30, 1960.

Third Cellulose Conference

The following is a provisional list of contributions to be presented at the Cellulose Research Institute, State University College of Forestry, Syracuse, N. Y., Oct. 26–28, 1960. The titles given are provisional and the order in which the contributions will be presented at the meeting will not be the same as in this list. It should be noted, also, that the list may not be quite complete, because correspondence about possible contributions from Soviet scientists is still in progress.

J. Ross Colvin—National Research Council of Canada, Ottawa, Ont., "The Chemical Structure of the Precursor of Bacterial Cellulose."

H. Meier—Swedish Forest Products Research Laboratory, Stockholm, Sweden, "On the Distribution of Polysaccharides in Deciduous and Coniferous Wood Fibers."

Russell Nelson—Buckeye Cellulose Corp., Memphis, Tenn., "The Use of Holocellulose to Study Cellulose Supermolecular Structure."

E. Treiber—Swedish Forest Products Research Laboratory Stockholm, Sweden, "The State of Solution of Technical Viscoses."

Robert F. Schwenker, Jr., Tetsuo Kinoshita, Karlin Buerling and Eugene Pacsu—Textile Research Institute, Princeton, N. J., "Preparation and Characterization of Sodium Cellulosates."

H. Kraessig—Industrial Cellulose Research, Ltd., Hawkesbury, Ont., "Morphology and Properties of Cellulosic Fibers."

Olavi Perila—Finland Institute of Technology, Helsinki, Finland, "The Chemical Composition of Carbohydrates of Wood Cells."

Toshikazu Fujimura—Kokohu Rayon and Pulp Co., Ltd., Japan, "Acetalization of Regenerated Cellulose Fibers with Di-Aldehydes."

W. Lenz—Dow Chemical Co., Midland Mich., "Application of Nuclear Magnetic Resonance to Structural Studies of Carbohydrates in Aqueous Solution."

Roy Whistler—Purdue University, Lafayette, Ind. Title not yet received.

M. Goodman—Polytechnic Institute, Brooklyn, N. Y. Title not yet received.

R. I. C. Michie, A. Sharples, and A. A. Walter—British Rayon Research Association, Manchester, England, "The Nature of Acid-Sensitive Linkages in Cellulose."

Frederick C. Leavitt—Dow Chemical Co., Framingham, Mass., "Crosslinking of Cellulose Derivatives with High Energy Radiation."

H. F. Mark—Polytechnic Institute, Brooklyn, N. Y. Title not yet received.

S. Mason—Pulp and Paper Research Institute of Canada, Montreal, Que., "Elongated Particles in a Velocity Gradient, and the Flexibility of Cellulose Fibers."

A. J. Morak, S. Kurath, and H. A. Swenson—The Institute of Paper Chemistry, Appleton, Wis., "The Sedimentation and Light Scattering Study of Hemicellulose from Spruce."

Mary E. Carter—American Viscose Corp., Marcus Hook, Pa., "Preparation, Characterization and Properties of a Deoxycellulose."

B. Ranby and Ralph Noe—Empire State Paper Research Institute, Syracuse, N. Y., "Crystallization of Cellulose Derivatives from Solution."

Eric Wellisch, Lamont Hagan, Leon Marker, and Orville J. Sweeting—Olin Mathieson Chemical Corp., New Haven, Conn., "Interaction of Cellulose with Small Molecules; The Relation of Softening Action and Hygroscopic Properties."

Douglas J. Bridgeford—Tee-Pak Inc., Chicago, Ill., "Copolymer Formation within Cellulosic Materials."

Douglas J. Bridgeford—Tee-Pak Inc., Chicago, Ill., "Staining Techniques Used to Indicate the Locus of Vinyl Polymers Formed in Cellulosic Materials."

D. F. Herman—National Lead Co., Brooklyn, N. Y. Title to be announced later.

S. Gabrail and W. Prins—Cellulose Research Institute, Syracuse, N. Y., "Thermodynamic Analysis of the Elasticity of Swollen Cellulose Filaments."

D. K. Ray Chaudhuri and J. J. Hermans, Cellulose Research Institute, Syracuse, N. Y., "Grafting onto Cellulosic Macromolecules through Chain Transfer to Mercapto-Ethyl Side Chains. II. Mechanism of the Process."

J. E. Luce and A. A. Robertson—Pulp and Paper Research Institute of Canada, Montreal, Que., "Sorption of Polymers on Cellulose."

John B. McKelvey, Ruth R. Benerito, Beverly G. Webre, and Ralph J. Berni—Southern Utilization Research and Development Division, Agricultural Research Service, U. S. Department of Agriculture, New Orleans, La., "The Cellulose-Butadiene Diepoxide Reaction and Its Effect on the Crease Resistance of Cotton."

Hajime Okamoto—Kyoto Prefectural University, Kyoto, Japan, "The Aging Process of Timber for Thousand Years at Ordinary Temperatures."

H. G. Higgins, C. M. Stewart, and K. J. Harrington—Division of Forest Products, Commonwealth Scientific and Industrial Research Organization, S. Melbourne, Australia, "Infrared Spectra of Cellulose and Related Polysaccharides."

Alexander Meller—Australian Paper Manufacturers Ltd., Melbourne, Australia, "Effect of Crystalline Structure on Alkaline Degradation of Cellulose."

Arnold J. Rosenthal—Celanese Corp. of America, Summit, N. J., "Kinetics of the Acid Catalyzed Degradation of Cellulose Esters."

Testile Research Institute, Toyl Spinning Co., Katada-cho Shiga-Pref., Japan, "γ-Ray Induced Graft Polymerization of Styrene onto Cellulose and Some Chemical Properties of the Grafted Polymer."

Certified Pulp Testers

The following is an up-to-date list of pulp testers approved by the Certified Pulp Testers Bureau, for 1960:

PULP AND PAPER MILL LABORATORIES

Adams, Walter R., Gulf States Paper Corp., Demopolis, Ala.

Allen, F. Mark, East Texas Pulp and Paper Co., P. O. Box 816, Silsbee, Tex.

Baril, Bernard, Quebec North Shore Paper Co., Bai Comeau, Que.

Bardsley, John H., British Columbia Forest Products, Ltd., Pulp Div., Crofton, B. C.

Benjamin, Morton, Owens-Illinois Jacksonville, Mill, P. O. Box 1620, Jacksonville 1, Fla.

Biggar, Robert J., Continental Paper Co., Ridgefield Park, N. J.

Bowan, C. D., Columbia Cellulose Co., Ltd., P. O. Box 1000, Prince Rupert, B. C.

Clark, Clarence T., Fraser Companies, Ltd., Edmunston, N. B.

Davidson, C. W., Crown Zellerbach Corp., Camas, Wash.

Eeman, L. R., MacMillan & Bloedell (Alberni), Ltd., Port Alberni, B. C.

Enghouse, Clarence A., Crown Zellerbach Corp., West Linn, Ore.

Gorhan, A. B., Ontario Paper Co., Ltd., Thorold, Ont.

Gray, W. S., Crown Zellerbach Canada, Ltd., Ocean Falls, B. C.

Hargraves, A. L., St. Joe Paper Co., Port St. Joe, Fla.

Ingram, C. D., Hollingsworth & Whitney Div., Scott Paper Co., P. O. Box 1189, Mobile, Ala.

Lea, N. S., Scott Paper Co., West Coast Div., Everett, Wash.

Magnusson, Norval, Puget Sound Pulp and Timber Co., Bellingham, Wash.

Marriott, Robert, Crown Zellerbach Corp., Port Townsend, Wash.

Mason, D. C., Anglo-Canadian Pulp and Paper Mills, Ltd., P. O. Box 1487, Quebec, Que.

Mayer, Clifford, Publishers Paper Co., Oregon City, Ore.

Neale, Raymond J., Thurso Pulp and Paper Co., Thurso, Que.

Tyler, L. M., Howard Paper Mills, Inc., Aetna Paper Div., Dayton 7, Ohio

Willcox, E. C., MacMillan & Bloedell, Ltd., Harmac Pulp Div., P. O. Drawer 18, Nanaimo, B. C.

Donald & Co., J. T. (1956), Ltd., 1181 Guy St., Montreal, Que.

Goodrich, Neil C., South Haven Terminal Co., Inc., 251 Center St., South Haven, Mich.

L. G. Vela, Galveston Laboratories, 1728 Market St., Galveston, Tex.

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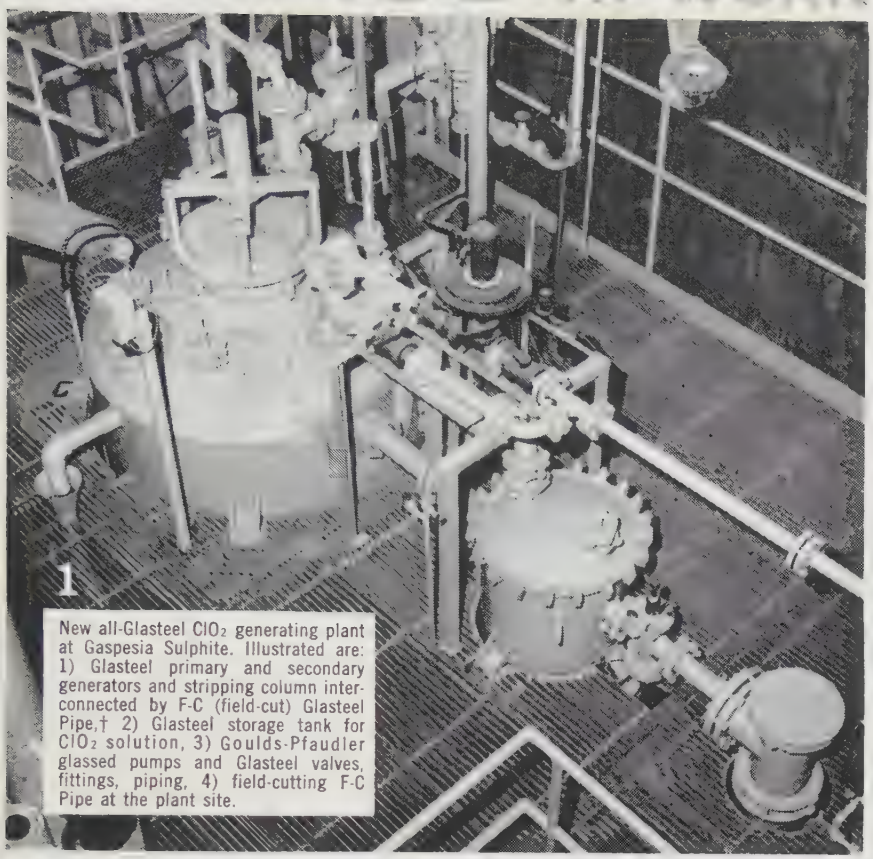
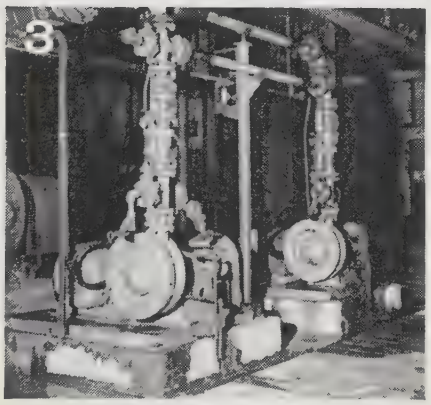


New all-Glasteel ClO_2 generating plant at Gaspesia Sulphite. Illustrated are: 1) Glasteel primary and secondary generators and stripping column interconnected by F-C (field-cut) Glasteel Pipe,† 2) Glasteel storage tank for ClO_2 solution, 3) Goulds-Pfaudler glassed pumps and Glasteel valves, fittings, piping, 4) field-cutting F-C Pipe at the plant site.



How to keep "puffs" down in generating ClO_2

Only two "puffs" since going on stream in November 1959. That's the record of the chlorine dioxide plant operated by Gaspesia Sulphite Company Ltd., Chandler, Quebec.

One of the important features of the "puffless wonder" is the extensive use of Pfaudler® Glasteel equipment — glass inside, steel outside.

Combat corrosion. With Glasteel you can not only keep "puffs" to a minimum, but also solve *all the corrosion problems* encountered in making and storing chlorine dioxide.

If you desire, you can get (as did Gaspesia) Pfaudler Project Engineering service to assist in the design of a complete "package" — primary and secondary generators; chlorate, chlorine dioxide, chemical, and waste liquor storage; scrubber, absorber, and stripper columns; pumps; piping; and instrumentation.

In wide use. You will find Pfaudler Glasteel equipment for ClO_2 generation used in 39 other progressive pulp mills. And always for the same reason: it is the most *economical* material available in terms of cost, maintenance and service life.

More information. For details on design, complete engineering, procurement, and installation of ClO_2 generating systems, write to our Pfaudler Division, Department TA-80, Rochester 3, New York.

*FLUIDICS is the Pfaudler Permutit program that integrates knowledge, equipment and experience in solving problems involving fluids.

†Patent applied for

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Landes, William, Paper and Pulp Testing Laboratory, 118 E. 28th St., New York, N. Y.
Orthman Laboratories, Inc., 407 E. Michigan Ave., Milwaukee, 2, Wis.
Skinner & Sherman, Inc., 227 California St., Newton 58, Mass.
Sutliff, John H., Font Grove Rd., Slingerlands, N. Y.
U. S. Testing Co., Inc., 1415 Park Ave., Hoboken, N. J.
Whittington, E. F., 530 W. Cedar St., Kalamazoo 45, Mich.
Wiley & Co., Inc., 904 N. Calvert St., Baltimore, Md.
Williams Apparatus Co., Inc., Herald Bldg., Watertown, N. Y.

Golden Anniversary—U. S. Forest Products Laboratory

Calls for more concentrated and expanded research were coupled with predictions that pulp and paper manufacturing will be greatly changed in the next 50 years as industry leaders joined with government officials, educators, and scientists to observe the Golden Anniversary of the U. S. Forest Products Laboratory held in Madison, Wis., June 2–4, 1960.

Speakers representing the whole category of wood products paid tribute to the half-century-old pioneer research institution for its contributions to virtually all fields of wood use. Scrolls, citations plaques, and messages of congratulations came from all branches of the industry and from abroad.

The Laboratory was founded here June 4, 1910, by the Forest Service, U. S. Department of Agriculture, in cooperation with the University of Wisconsin. Among other tokens of industry recognition it received over the anniversary week end was a large plaque from the American Paper and Pulp Association. Walter Swanson, vice-president and director of research and development for Kimberly-Clark Corp., Neenah, Wis., made the presentation. The plaque was inscribed:

"For distinguished achievements in pulp and paper research, notably Semichemical and Cold Soda processes that greatly enhanced the utility of hardwoods, this plaque is presented the Forest Products Laboratory on its golden anniversary, June 2–4, 1960. American Paper and Pulp Association."

The pulp and paper industry's main speaker at the celebration was Howard E. Whitaker, chairman of the board of The Mead Corp., Chillicothe, Ohio, and president of APPA. Forecasting important basic changes, Whitaker declared:

"We who have spent our working lives in this industry are constantly amazed at the variety of problems unsolved, and the fascinating challenge they represent."

While much has been learned about tree growth conditions, something about insect and disease control, and a little about genetics of trees, Whitaker said, "all this knowledge is still very much a collection of data."

"When we learn the underlying laws, then only will we be able to proceed to use our lands to best advantage . . . Perhaps in 50 years our production timberlands will look like giant cornfields."

Whitaker proposed that, instead of just taking "convenient sized pulpwood logs" and throwing the test of the tree away, the whole tree be "chewed up" on the spot, branches, twigs, and all. Similarly, he deplored loss of wood chemicals in pulping.

"In the next 50 years," he declared, "we want research to show us how to convert all of the wood into useful products, lignin and all. Perhaps we will eventually put the whole tree into solution, cellulose fiber as well, then split it by distillation or some other means into 100 or more separate products, including an artificial fiber to be respun out of one of the components, a fiber of reasonably uniform characteristics which will not give us so many headaches as the present fibers do in making paper . . .

"I often wonder if our paper mills

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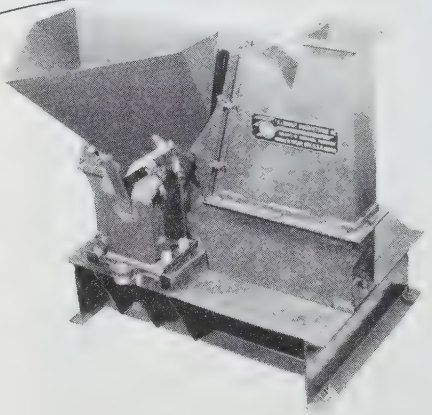

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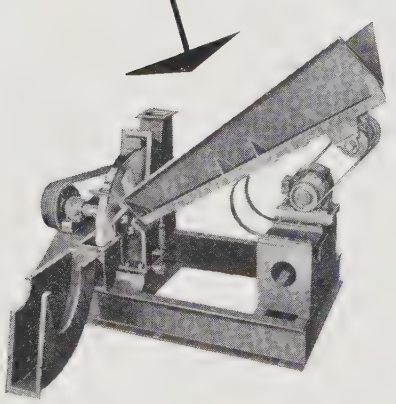

Capacity 400 to 500 cubic feet per hour with 1/2" chips and vibrating feeder.

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could not make much more money out of the so-called by-products of the tree than they ever did out of paper."

Whitaker predicted—"maybe in 30 years or so"—a reconstituted cellulose fiber of standard dimensions and properties. He saw this as a natural result of the fact "the paper industry is fast getting mixed up with the plastic and resin industry." Plastics, he said, have one natural advantage, uniformity.

Pulp mills will move toward an automatic, continuous process, and papermaking equipment will change, Whitaker continued.

"The paper machines—well, they haven't changed much since the first one was invented back in 1800. They just become bigger and more complicated and more expensive. Surely there must be a better way to weave fibers together into a continuous sheet. Perhaps we have devoted too much emphasis to chemistry, and have neglected the field of physics and mechanical design in our industry.

"The development of the electrical transistor, and the whole marvelous conception of miniaturized instruments and controls which ride in our satellites today is a shining example of what research and imagination can accomplish. The point is that it takes more than just chemistry or physics, but also a highly developed skill in mechanics to produce the final results.

"The future in forest products research offers a world of fascinating prospects. The young men who will accomplish many of these changes are living today, at work in our laboratories, and are numbered among the students in our technical schools. Fifty years from now at another anniversary meeting, they will look back and laugh at the way we make pulp and paper today."

Frederick K. Weyerhaeuser, chairman of the board of the Weyerhaeuser Co., St. Paul, Minn., spoke on the same industry panel with Mr. Whitaker. Representing primarily the lumber industry, Mr. Weyerhaeuser pointed out that pulp and paper, also made by his firm, spends about 1% of its sales dollar for research, "and lumber substantially less than that."

"Industries that compete with wood, such as aluminum and plastics," he declared, "approach 4% of their sales dollar in research expenditures."

Stanton W. Mead, speaking at the Governor's luncheon Friday, June 3, gave an intimate glimpse of how the firm of which he is president, Consolidated Water Power and Paper Co. of Wisconsin Rapids, has benefited over the years through Forest Products Laboratory research.

Mead attributed several major developments in his firm—its sulfite pulping, its forestry program, its paper plastic production, and most recently its semichemical pulping—to the Laboratory's research.

But this research, he emphasized, has been beneficial to many others besides the company's stockholders. By providing a market for locally grown hardwoods, semichemical pulping at the Wisconsin Rapids mill alone meant $620,000 last winter for local farmers and other rural residents, Mr, Mead disclosed. The firm bought 20,000 cords of mixed hardwood pulpwood.

"I think these citations of the contributions to the paper industry in knowledge, understanding, and progress in new areas are convincing evidence of the lab's great value to our society." Mr. Mead said. "While the ones I have cited are only those of personal experience, I know and many others know that the lab's pioneering in other fields has been equally significant and productive. Their goal of greater utilization of the forests and greater understanding of forest values is definitely productive, and definitely rewarding to our nation as a whole.

"I feel privileged as one spokesman for our pulp and paper industry to express appreciation publicly to the Forest Products Laboratory on their Golden Anniversary and to wish them continued progress in this vital endeavor."

One of the research engineers who pioneered neutral sulfite

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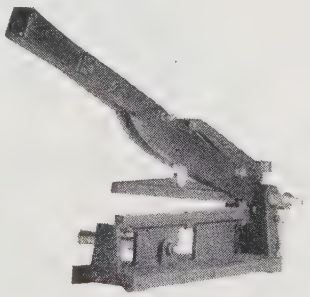

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This plaque was unveiled Friday, June 3, at Madison, Wis., where it was presented to the Forest Products Laboratory on the golden anniversary of the world's first such research institution. Shown at presentation ceremonies are, left to right: Gardner H. Chidester, chief of the Laboratory's division of pulp and paper; Director Edward G. Locke; Howard E. Whitaker, president of the presenting organization, the American Paper and Pulp Association and Board Chairman of the Mead Corp., Chillicothe, Ohio; and Joseph A. Staidl, retired research engineer who worked on the Laboratory's original semichemical process for pulping hardwoods. Staidl still does consulting work

semichemical pulping at the Laboratory, J. A. Staidl, recalled events leading to its early commercial development. The late Sidney Wells, he said, conceived the idea of disintegrating chemically treated chips in a rod mill. The idea worked, and got its first trial on waste chestnut chips from which tannin had been extracted. The chips, extracted by the Southern Extract Co. at Knoxville, Tenn., were then used for fuel worth $2 a ton, Staidl recalled. The company began production of 9-pt. corrugating board from chestnut fiber in 1926. Many improvements since then have made such pulps suitable for many kinds of papers.

From its very start, the Laboratory has pushed pulp and paper research as one of its main lines of work, declared Richard E. McArdle, chief of the Forest Service, in reviewing accomplishments of the past 50 years. When the Laboratory was launched in 1910, he said, the then chief forester, Henry Solon Graves, outlined pulp and paper as a major research field.

"I think," Mr. McArdle said, "that his (Graves') aspirations here have been rather dramatically fufilled. The Laboratory's development of semichemical pulping is rapidly becoming a major means of bringing into use extensive hardwood forests largely unsuited for construction lumber.

"This development and its more recent variant, cold soda pulping, yield 50 to 75% more pulp from wood than the older chemical processes, thereby curtailing waste and pollution."

Mr McArdle also praised the Laboratory's fundamental research on wood chemistry that has helped bring about "many notable achievements such as dissolving pulps for plastics, synthetic fibers, films, and other products in which wood, as wood, is unrecognizable."

Mr. McArdle called for new processes that utilize wood as a chemical raw material to "convert into widely useful things the low-grade, small timber that now in a sense wastes much of our forest land. We need those processes to help pay the cost of rehabilitating those forests, making them more productive."

Assistant Secretary of Agriculture Ervin L. Peterson, main banquet speaker, called for "creative forestry" that manages timberlands for maximum benefits in all their uses. He forecast that an expanding population, coupled with declining forest acreages, would place increasing demands on forests not only for timber but for recreation, water, grazing,

The highest honor of the U. S. Department of Agriculture, its distinguished service award, was presented to the Forest Products Laboratory at its 50th birthday party in Madison, Wis. Above, E. C. Betts, Jr., department personnel director, hands the award to Laboratory Director Edward G. Locke

and wildlife. Forest managers will have to consider all these uses, Peterson said, although timber will undoubtedly have to continue paying the bills for some time to come.

Honors received by the Laboratory included the Department of Agriculture's highest, its distinguished service award. Industry organizations besides APPA presenting plaques and scrolls were the National Lumber Manufacturers Association, the Insulation Board Institute, the American Institute of Timber Construction, the Douglas-Fir Plywood Association, the Home Manufacturers Association, and the American Wood-Preservers Association. Plaques, citations, and messages of congratulations came also from such nations as Finland, Germany, Australia, New Zealand, Canada, and the Philippines.

Other top industry leaders who joined in congratulating the pioneer federal laboratory included W. E. Difford, executive vice-president of the Douglas-Fir Plywood Association, Tacoma, Wash.; George E. Price, president of National Homes, Inc., Lafayette, Ind., the nation's largest producer of prefabricated houses; Frank J. Hanrahan, executive vice-president of the American Institute of Timber Construction; and Samuel Lenher, noted organic chemist and vice-president and research adviser of E. I. du Pont de Nemours, Inc., Wilmington, Del.

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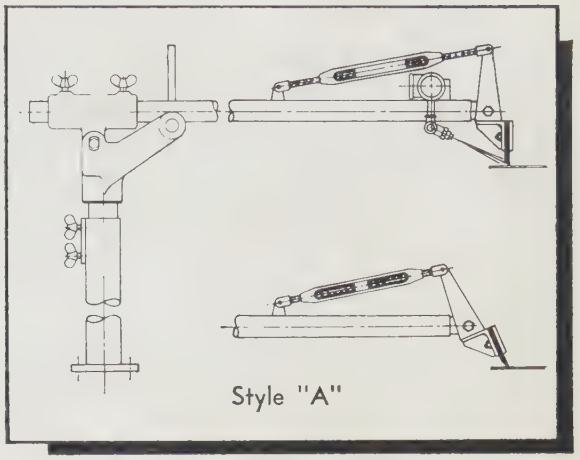

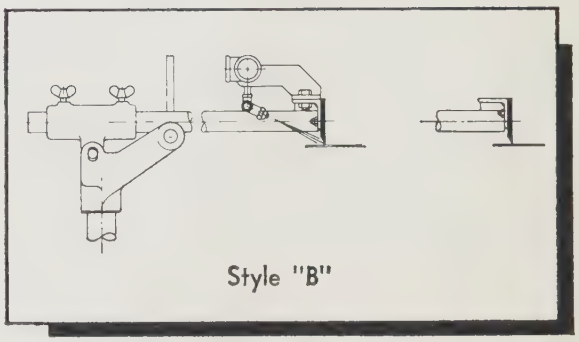

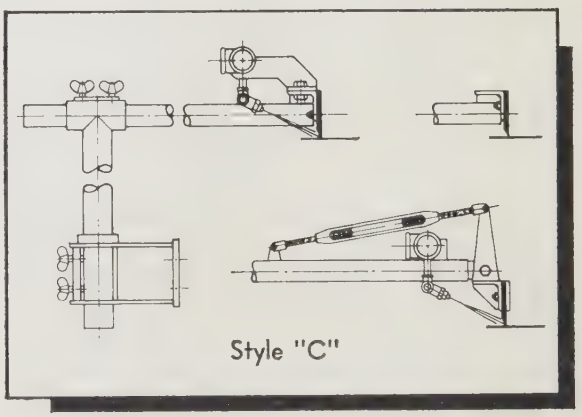

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TAPPI NOTES

Classes of Association Membership

An announcement in this issue (see "Association News and Events") describes the amendment of the Association Constitution which will eliminate the class of "overseas members." After corresponding changes have been made in the Bylaws, all individual members presently assigned to the overseas grade will be reassigned as active, associate, affiliate, or student members depending upon their technical qualifications.

Since there is some confusion even among TAPPI members in this country as to the qualifications required for the various classes of membership, a brief review of these may be helpful.

All applications for membership are reviewed by the Executive Committee, which is empowered to assign applicants to the grade to which their qualifications entitle them. Similarly, members may be transferred from one grade to a higher grade only upon approval by the Executive Committee.

Active members represent the highest grade of individual membership in the Association. They are the only individual members who are entitled to vote and serve as officers of the Association. An active member shall have had (1) a technical training, (2) at least ten years of experience in the paper industry or in work of a technical nature in related industries (this period may include his technical schooling), and (3) a position of responsibility for at least three years.

Associate members are the largest class of individual members in the Association. They receive the same services and publications as active members but are not entitled to vote or serve as officers of the Association. An associate member shall have had (1) at least five years of experience in the paper industry or in related industries (this period may include his technical schooling), and (2) a responsible position for at least one year. Many members who entered the Association as associate members are now fully qualified for elevation to the active grade. In some instances they may not understand the added benefits of active membership; in others they may simply not realize that they are associate rather than active members. An interested member can determine his grade quickly by referring to his annual membership card or to the membership directory of the Yearbook. In the latter case "M" denotes an active, "A" an associate, "F" an affiliate, and "S" a student member.

An associate member who believes he is now qualified for assignment as an active member should notify the Association headquarters office of his desire to be transferred, so that the appropriate request can be submitted to the Executive Committee. The Association will not initiate action on such a transfer unless it is requested by the associate member.

Student members receive the same services and publications as active and associate members. By definition a student member shall be (1) a full-time student and candidate for a degree at a recognized school or (2) an individual under twenty-four years of age who is qualified to hold a subordinate position of a technical nature in the paper industry.

Student members who qualify by virtue of their age will be automatically reassigned to the associate grade when they become twenty-four years of age.

Last year a second type of student membership was authorized. The requirements for this *special student* membership are as follows:

A student at a university, college, or technical institute may have the option of becoming a member of the Association under the following terms: (1) Payment of the initiation fee can be postponed until the student enters the industry and qualifies for associate membership. (2) Payment of an annual fee of four dollars, after he has applied by special forms of application which may be obtained from his educational institution. (3) Application for this special form of student membership must be reviewed each year. (4) Services to student members using this option will be limited to receipt of the Association's magazine *Tappi*.

Affiliate members are those individual members who are interested in the objectives of the Association and who either are not completely qualified or do not wish to become active or associate members. Many librarians fall in this membership category. Affiliate members receive the same services and publications as the other classes of individual members.

Finally *retired members* are those individuals who have been members of the Association for at least twenty-five years and who have retired from active employment. Upon application to and approval of the Executive Committee, the annual dues of retired members may be remitted, and they will continue to receive the Association's magazine.

Although TAPPI is primarily a society of individuals, slightly over 500 of the Association's 10,000 members are company members. Two types of company membership are available to organizations which endorse Association policies and activities.

Corporate members are firms actively engaged in the manufacture of pulp and paper.

Sustaining members are firms in related industries providing equipment, materials, and services to pulp and paper manufacturers.

Within this membership structure the Association endeavors to classify members in a manner which will accurately reflect their qualifications and their interests. Each member is urged to notify the headquarters office if his classification is no longer correct. Maintaining accurate records will benefit both the individual member and the Association.

Philip E. Nethercut

PERSONAL MENTION

New TAPPI Members

Kenneth S. Allen, Chief Acquisitions Librarian, University of Washington, Seattle, Wash., a 1952 graduate of University of Washington.

Charles O. Anastasio, Project Engineer, Lowe Paper Co., Ridgefield, N. J. Attended Fairleigh Dickinson College.

Clarence H. Anderson, Chemist, Olympic Research Div., Rayonier Incorporated, Shelton, Wash., a 1934 graduate of University of Washington.

Robert Bruce Arnold, Research Engineer, Scott Paper Co., Chester, Pa., a 1957 graduate of University of Maine.

Eero S. Avela, Director of Research, Oy Kaukas Ab, Lappeenranta, Finland.

Francesco Badocchi, Technical Engineer, S. P. A. Cartiere Ambrogio Binda, Milano, Italy, a 1949 graduate of Politechnico Di Milano.

Thomas A. Bradley, Jr., Plant Manager, Union Bag-Camp, Affton, Miss. Attended Mississippi State College.

William A. Buhler, Industrial Engineer, Martin Paper Products, Ltd., New Westminister, B. C., Canada, a 1950 graduate of University of British Columbia.

Thomas L. Calhoun, Management Trainee, New York & Pennsylvania Co., Lock Haven, Pa., a 1958 graduate of Lycoming College.

Sidney M. Cone, Jr., Vice-President, Cone Mills Corp., Greensboro, N. C., a 1904 graduate of John Hopkins University.

Wm. L. Cunningham, Development Engineer, Sandwell & Co., Ltd., Vancouver, B. C., Canada, a 1936 graduate of University of British Columbia.

Jack L. Diltz, Sales Engineer, Beloit Iron Works, Beloit, Wis., a 1949 graduate of University of Cincinnati.

Henry P. Evans, Staff Consultant, C. F. Braun & Co., Alhambra, Calif., a 1932 graduate of Carnegie Institute of Technology.

Wesley A. Flower, White Water Engineer, Howard Paper Mills, Inc., Dayton, Ohio, a 1958 graduate of New York State College of Forestry.

Daniel P. Folsom, Technical Sales Representative, Monsanto Chemical Co., St. Louis, Mo., a 1954 graduate of University of Maine.

Reid G. Fordyce, Director, Research and Development, Fome-Cor Corp., Springfield, Mass., a 1935 graduate of British Columbia University with a Ph.D. degree in 1939 from McGill University.

William A. Forest, General Manager, Poirier Control Co., Inc., Waterville, Me.

Robert D. Fraik, Research Investigator, New Jersey Zinc Co. (of Pa.), Palmerton, Pa., a 1958 graduate of Western Michigan College.

George H. Goldsborough, Staff Specialist, U. S. Dept. of Agriculture, Washington, D. C., a 1939 graduate of Cornell University.

Robert L. Gooch, Application Engineer, General Electric Co., San Francisco, Calif., a 1941 graduate of Stanford University.

William T. Goward, Technical Service Representative, Clinton Corn Processing Co., Clinton, Ia., a 1940 graduate of Bergen Jr. College.

Dana A. Hambleton, Pulp & Paper Sales Div., The Foxboro Co., Foxboro, Mass., a 1959 graduate of University of Maine.

Clarence B. Hanford, Technical Sales, Hercules Powder Co. Wilmington, Del., a 1950 graduate of Iowa State College.

John F. Harvey, Librarian, Drexel Institute of Technology Library, Philadelphia, Pa.

W. Kingsley Hastey, Resident Manager, St. Lawrence Corp., Ltd., Three Rivers, Que., Canada, a 1940 graduate of Queens University.

Ray K. Holm, Electrical Engineer, Blandin Paper Co., Grand Rapids, Minn., a 1950 graduate of Michigan College of Mining & Technology.

Eugene B. Jackson, Librarian, Research Laboratories, General Motors Corp., Warren, Mich.

Llewellyn Jehu, Welding & Research Engineer, Dominion Bridge Co., Ltd., Lachine, Que., Canada, a 1930 graduate of McGill University.

Irwin J. W. Johnston, Engineer, Dorr-Oliver, Inc., Atlanta, Ga., a 1932 graduate of University of Toronto.

Bernard J. Jones, Research Engineer, Champion Paper & Fiber Co., Hamilton, Ohio, a 1959 graduate of University of Cincinnati.

Thomas G. Kenyon, Jr., Packaging Engineer, The Sperry and Hutchinson Co., Metuchen, N. J., a 1950 graduate of Purdue University.

Jerome W. Kirschbaum, Laboratory Supervisor, Container Laboratories, Inc , New York, N. Y., Attended Brooklyn College.

Kauko U. Konttinen, Chief Design Engineer, Valmet Oy, Jyvaskyla, Finland, a 1938 graduate of Finland Institute of Technology.

Radomir Krunic, Technical Manager, Fabrika Celuloze i Viskoze u Izgradnji, Banja Luka, Jugoslavia. Attended University of Belgrade.

Frederick W. Lancaster, Librarian, Babcock & Wilcox Co., Barberton, Ohio.

German G-C. Lopez, Director, Fabrica Nacional De Moneda Y Timbre, Burgos, Spain, a 1936 graduate of Escuela Superior Ingenieros Industriales with a Ph.D. degree.

Edoardo Loser, Technical Manager, S.p.A. Gia Barone Ambrogio & Figlio, Torino, Italy, a 1954 graduate of Trieste University.

Madhav Narayan Marathe, Chief Research Officer, Birla Institute of Scientific & Industrial Research, Nagda, India, a 1953 graduate of University of Bombay.

Francesco A. Marsoni, General Director, Cartiere Cartstecnica del Piave, Treviso, Italy, a 1925 graduate of University of Milan.

Barney W. McCanna, Mill Chemist, St. Lawrence Corporation, Ltd., Red Rock, Ont., Canada. Attended St. John's College.

Roger W. Moister, South East District Manager, Wyandotte Chemicals Corp., Atlanta, Ga., a 1935 graduate of University of Virginia.

Navada G. Montgomery, Librarian, U. S. Naval Supply Research & Development Facility, Naval Supply Center, Bayonne, N. J., a 1933 graduate of College of Wooster.

George A. T. Moore, Administrative Sales Assistant, A. E. Staley Manufacturing Co., Decatur, Ill., a 1950 graduate of Syracuse College.

Wazo Morimoto, Research Engineer, Rengoshiki K. K., Osaka, Japan, a 1950 graduate of Ritsumeikan University.

David L. Mosher, Technical Superintendent, Fibreboard Paper Products Corp., Port Angeles, Wash., a 1951 graduate of Linfield College.

Thomas E. O'Hare, Staff Engineer-Economist, M. W. Kellogg Co., New York, N. Y., a 1951 graduate of College of the City of New York.

Curt O. Ramsel, Chief Engineer, AB Stjernfors-Stalldalen, Stalldalen, Sweden.

Hugh W. Richards, Staff Assistant, Wood Cellulose Development, Eastman Kodak Co., Rochester, N. Y., a 1943 graduate of Lehigh University.

Hans M. Riessner, Design Engineer, H. A. Simons, Ltd., Vancouver, B. C., Canada. Attended Erlangen College, Germany.

Milton G. Shaw, Chemical Engineer, New York & Pennsylvania Co., Inc., Johnsonburg, Pa., a 1958 graduate of University of Pittsburgh.

Alex Sigal, Technical Director, Pabst Brewing Co., Milwaukee, Wis., a 1929 graduate of Ohio State University with a Ph.D. degree in 1937 from University of Pittsburgh.

Yosikazu Sirakawa, Chemical Engineer, Kokusaka Pulp Co., Ltd., Tokyo, Japan, a 1957 graduate of Hokkaido University.

Leo J. Sobell, Assistant Sales Manager, American Cyanamid Co., Bound Brook, N. J., a 1948 graduate of University of Alabama.

Lester G. Stine, Management Consultant & Partner, Associated Industrial Consultants, Trenton, N. J., a 1944 graduate of Pennsylvania State University.

Dennis H. J. White, Head, Sturtevant Drying Div., Sturtevant Engineering Co., Ltd., London, England. Attended South East Essex Technical College.

Shunpei Yamuchi, Chief, Head Design Office, Hitachi Shipbuilding & Engineering Co., Ltd., Osaka, Japan, a 1928 graduate of Tokyo Emperial University.

Isamu Yoshino, Chief, Research Laboratory of The Kokusaku Pulp Industry Ind. Co., Ltd., Tokyo, Japan, a 1959 graduate of Tokyo Institute of Technology with a Ph.D. degree.

Appointments

William Acton, formerly with Pulp and Paper Research Co., Ltd., is now a Consulting Engineer for Manderstam Technical Services, Ltd., 38 Grosvenor Gardens, London, S. W. 1, England.

Derry Ackeroyd, formerly of Beloit Iron Works, is now Assistant Mill Manager of Crocker-Burbank & Co. Assoc., Fitchburg, Mass.

Gordon F. Allo, is now Assistant General Sales Manager for Bathurst Paper Sales, Ltd., Montreal, P. Q., Canada.

Nils O. Arve, formerly of Wifstavarfs A/B is now Manager of the new sulfate mill of Skogsarnas Industri A/B, Morrums Bruk A/B, Morrum, Sweden.

Louis O. Barber, formerly of Zimmer Paper Products Co., is now Supervisor of Austill Waxed Paper Co., Jacksonville, Fla.

John A. Beaujean, formerly of Calcasieu Paper Co., is now Technical Director of Lumberton Pulp Co., Lumberton, Miss.

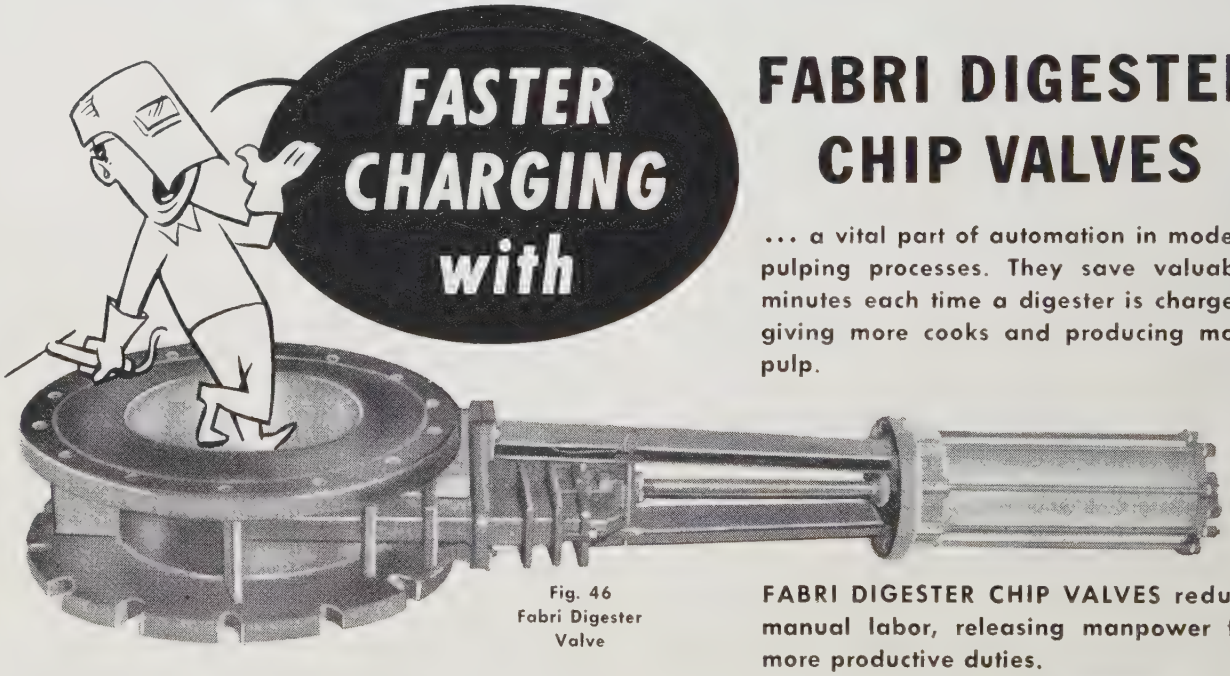
George K. Boger, Jr., formerly of Amalgamated Chemical Corp., is now Manager of engineering economics for the Fiber Products Research Center, Inc., Beaver Falls, N. Y.

Robert E. Bringman is now Sales Manager for the specialty papers and pulp division of Gilman Paper Co., New York, N. Y.

Joseph Brown, formerly of Tupman Thurlow Co., Inc., is now with the New York Sancor Corp., New York, N. Y.

Malcolm A. Campbell, formerly of Hinde & Dauch Paper Co. of Canada, Ltd., is now Sales Manager for shipping case materials for the St. Lawrence Corp. Ltd., Montreal, P. Q.

Donald H. Carlson, formerly a Student at the Institute of Paper Chemistry, is now Head Shift Chemist for the Southern Division of Scott Paper Co., Mobile, Ala.



FABRI DIGESTER CHIP VALVES

... a vital part of automation in modern pulping processes. They save valuable minutes each time a digester is charged, giving more cooks and producing more pulp.

Fig. 46
Fabri Digester Valve

FABRI DIGESTER CHIP VALVES reduce manual labor, releasing manpower for more productive duties.

- Eliminate time-consuming bolting of conventional digester cover.
- Resilient seat for tight closure.
- Deep Gate stuffing box with lantern ring packing.
- Approved by insurance underwriters.
- Cylinder or Electric motor operation.

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Douglas H. Clark, formerly Chemist at St. Regis Paper Co. is now with St. Lawrence Corp., Ltd., Red Rock, Ont.

Cornelius A. Cunningham, formerly with National Starch & Chemical Corp., is now a Chemist with Dennison Mfg. Co., Framingham, Mass.

Peter De Waard, formerly of the Hercules Powder Co., is now the European Representative of the special commodities division of General Mill, Inc., The Hague, Holland.

Richard G. Elliott, formerly of Oregon Forest Products Laboratory, is now a Project Engineer for Longview Fibre Co., Longview, Wash.

David Evans, formerly of West Virginia Pulp & Paper Co., is now a Project Engineer for Weyerhaeuser Co., Longview, Wash.

J. Alden Extrom, formerly of Chase Bag Co., is now Manager of Manufacturing for the Packaging Materials Corp., New York, N. Y.

Kenneth L. Fischer, formerly of Paper Products Mfg. Co., is now a Commodity Industry Analyst for the U. S. Tariff Commission, Washington, D. C.

Charles J. Fisher is now Vice-President in charge of manufacture for Wyomissing Paper Products Division, Narrow Fabric Co., Reading, Pa.

Myron Flotow, formerly of Mohawk Paper Mills, Inc., is now Assistant to the Vice-President in charge of production, Fitchburg Paper Co., Fitchburg, Mass.

Joachim Friese, formerly of Consolidated Paper Corp., is now a Project Engineer for J. M. Voith, Heidenheim/Brenz, Germany.

John W. Gladstone is now Technical Service Superintendent for the Halifax Paper Co., Roanoke Rapids, N. C.

Ronald G. Goodwin, formerly of Black-Clawson Co., is now Vice-President in charge of pulping development for Bauer Bros. Co., Springfield, Ohio.

John J. Goss is now Assistant Resident Manager for the Gaylord Container Division, Crown Zellerbach Corp., Bogalusa, La.

Alfred Graef is now Technical Assistant to the Vice-President in charge of the pulp and paperboard division of the Weyerhaeuser Co., Tacoma, Wash.

William T. Heyse, formerly of the U. S. Army, is now Technical Service Engineer for C. H. Dexter & Sons, Windsor Locks, Conn.

Edward R. Hoffman, formerly of the Oxford Paper Co., is now Supervisor of Statistical Services for the St. Regis Paper Co., Research and Development Department, Carthage, N. Y.

Anton J. Horstman is now Assistant to the Administrative Vice-President of Bauer Bros. Co., Springfield, Ohio.

James E. Irvine is now Vice-President in charge of engineering of Bauer Bros. Co., Springfield, Ohio.

Yong-Tsiang Kao, formerly of Papelera Pulpa-Cuba S/A, is now a Chemical Engineer for Parsons & Whittemore Co., New York, N. Y.

Edward W. Keith, formerly retired, is now Superintendent of the sulfate pulp mill of Eastern Fine Paper & Pulp Division of Standard Packaging Corp., Lincoln, Me.

James D. Stinchcombe is now Assistant Manager, staff engineering, for Scott Paper Co.

Carl C. Kesler is now Vice-President in charge of research and development for Penick & Ford Ltd., Inc., Cedar Rapids, Iowa.

John E. Killinger is now Vice-President in charge of technical sales service for Penick & Ford Ltd., Inc., Cedar Rapids, Iowa.

Robert R. Kindron is now Manager of pulp and paper application for Food Machinery & Chemical Corp., Princeton, N. J.

David B. Kuhe, formerly of Hudson Pulp & Paper Co., is now Vice-President of Lutcher Cellulose S/A, Sao Paulo, Brazil.

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Carthage 39" Chipper produces maximum percentage of chips to desired length—minimum fines. Available for gravity discharge or blowing in any direction. Horizontal feed spout for easy handling of long pieces.

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Simply interchanging the lower test plates of the Gurley-Hill S-P-S Tester converts this instrument for testing smoothness, porosity or softness of any printing and most industrial papers. Meets TAPPI and ASTM "Suggested Method for Determining Smoothness," as well as standard methods for finding air resistance or porosity.

Write for Bulletin 1400, describing complete line of Gurley paper testers.

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C. C. Landegger is now Executive Vice-President of the Black Clawson Co., New York, N. Y.

Rene P. Lapeze, formerly Professor at the French School of Paper Making, Grenoble, France, is now with Cartonneries de la Rochette, Grenoble, Isère, France.

David C. Lea of Olin-Mathieson Chemical Corp. has been transferred from Monroe, La., to Pisgah Forest, N. C., as Director of Research and Development for Ecusta Paper Operations.

Norman M. Le Maistre, formerly of Container Corp. of America, is now Production Control Superintendent for the Continental Can Co., Inc., Robert Gair Paper Product Group, Augusta, Ga.

J. McK. Limerick is now Research Director of Bathurst Power & Paper Co., Ltd., Montreal, P. Q.

Kenneth C. Logan, formerly of Northeastern Paperboard Products, Ltd., is now Director of Development for Anglo Paper Products, Ltd., Quebec, P. Q.

Robert W. Lull of American Cyanamid Co. has been transferred from Portland, Ore., to New York, N. Y., as Manager of Technical Service.

James Mardon, formerly of Northeastern Paper Products, is now Chief Papermaking Research Engineer for Oxford Paper Co., Rumford, Me.

Thomas F. Martin, formerly of Fibreboard Paper Products Corp., is now with Champion Paper & Fibre Co., Hamilton, Ohio.

James H. McClure, formerly of Allied Paper Corp., is now President of Timber Products, Inc., Allegan, Mich.

Duncan McDonald of the International Paper Co. has been transferred from Moss Point, Miss., to Georgetown, S. C., as Technical Director.

H. Wells Meakin is now Vice-President in charge of the pulp and paper division of J. E. Sirrine Co., Greenville, S. C.

David S. Most, formerly of Halifax Paper Co., is now Assistant General Manager of Northern Liquors, Inc., Lynn, Mass.

Harold De V. Partridge, formerly of the Brown Co., is now Manager of Pulp and Paper Development for Hooker Chemical Co., Niagara Falls, N. Y.

William E. Patte, formerly of Garden City Paper Mills Co., Ltd., is now a Project Engineer for Consolidated Paper Corp., Ltd., Grandmere, P. Q.

Jose Ramon C. Pesot, formerly of Papelera de Tetuan S/A (Morocco), is now with Papelera del Cid, S/A, Madrid, Spain.

John C. Pevear, formerly of West Virginia Pulp & Paper Co., is now a Mechanical Engineer for D. M. Bare Paper Co., Roaring Spring, Pa.

Alex Pociluyko, formerly of Marinette Paper Co., is now with the chemical research division of Scott Paper Co., Chester, Pa.

David F. Pollard is now Assistant Manager of Manufacture for Great Northern Paper Co., E. Millinocket, Me.

Dalton L. Pollet is now Assistant Production Manager of Gaylord Container Division, Crown Zellerbach Corp., Bogalusa, La.

George A. Richter, formerly of the Brown Co., is now a Consultant to the cellulose industry, Pittsford, N. Y.

Gilbert C. Robinson is now Regional Engineer for the Hinde & Dauch Division of West Virginia Pulp & Paper Co., Chicago, Ill.

Sergio Roggero, formerly of Cartiere Burgo, is now in the sales department of Beloit Italia, Turin, Italy.

Julius E. Sapp is now Production Superintendent of Gaylord Container Division of Crown Zellerbach Corp., Bogalusa, La.

Milton O. Schur is now Vice-President for research and development for the packaging division of Olin-Mathieson Chemical Corp., Pisgah Forest, N. C.

Charles E. Spear of the Stauffer Chemical Co. has been transferred from San Francisco, Calif., to Houston, Texas, as regional manager for market development.

Arthur W. Tackaberry, formerly Chief Engineer of Mac Sim Bar Paper Co., is now with Champion Cellulose S/A, Campinas, Brazil.

Norman S. Thompson, formerly Research Chemist with the Olympic Research Division of Rayonier, Inc., is now at the Institute of Paper Chemistry, Appleton, Wis.

Paul W. Thompson is now Sales Manager for Shuler & Benninghofen, Hamilton, Ohio.

Robert W. Turner is now Director of Bowater Paper Co., Pty. Ltd., Sydney, N.S.W., Australia.

Walter Utschig is now Associated Director of Material Services for the General Foods Corp., White Plains, N. Y.

Ramiro Villarreal, Q., formerly of the Instituto Mexicano de Invest. Tecnologicas, is now technical superintendent of Celulosa Nacional S/A, Rio Bravo, Tamps., Mexico.

Robert H. Walker, formerly of the Eastern Corp., is now a Project Engineer for Fitchburg Paper Co., Fitchburg, Mass.

William J. Weiss, formerly of Union Bag-Camp Paper Corp., is now a Process Engineer for Union Carbide Plastics Co., Bound Brook, N. J.

Albert P. Yundt, formerly with the Alac Co., is now Research Director for Bird & Son, E. Walpole, Mass.

Thomas G. Zentner, formerly of Diamond National Co., is now Director of Research and Development for the Forest Products Division of Olin Mathieson Chemical Corp., W. Monroe, La.

* * *

Hazim Hasic, Director General, is now the official corporate representative of Tvornica Sulfatne Celuloze Natron Papira, Maglaj, Jugoslavia, succeeding *Ilija Kovacevic.*

INDUSTRY NOTES

North American

Statistics[a]

Paper and Paperboard Production

Production of paper and paperboard in the first four months of 1960 totaled an estimated 11.7 million tons. This was a new four-month high, and marked a 5% gain over the year-earlier total. Paper production totaled 5.3 million tons, 8% above the corresponding year-earlier total. Paperboard production, at 5.4 million tons, showed a 3% gain, while production of construction paper and paperboard, at 1.0 million tons, showed little change over output in the first four months of 1959.

Among the major grades of paper, the largest gain—22.9%—took place in output of paper-machine coated printing and converting paper, with most of the increase centered on coated two sides, paper. Output of printing and publishing firms, by way of comparison (as measured by the Federal Reserve Board's printing and publishing output index) gained 6.5%. The gain in uncoated book paper production—9.5%—was more in line with that of printing and publishing firms. Newsprint production showed a gain of 7.7%, compared to an estimated 5% increase in the Federal Reserve Board index of output of newspapers.

Coarse paper output moved roughly in line with industrial production, showing a 7.5% gain from the first quarter of 1959 to the first quarter of 1960. Among the coarse paper grades, however, gains were widely distributed, varying from a 1.6% increase for wrapping paper to a 10.9% increase for bag paper.

Above-average gains were recorded in output of special industrial papers—11.2%—and sanitary papers—9.8%. The gain in special industrial papers was much greater than that for total industrial production. Similarly, the gain in output of sanitary papers was far above the estimated $3^1/_2$% gain in consumers' expenditures on all nondurable goods.

Among the major paperboard grades, the largest gains took place in output of special food board: 13.8% above the year-earlier total. Special food board has been one of the fastest growing grades during the postwar period, and current data indicate that this growth is continuing. Output of folding boxboard showed only a moderate gain over the year-earlier total in the first quarter of 1960, while output of setup boxboard declined by 3.4%. Containerboard showed a greater-than-average gain of 6.0%.

The 2.7% gain in construction paper and board output was the resultant of rather wide variations among the various grades. Output of construction paper dropped by 2.2%, insulating board declined by 1.3%, while hard pressed wood fiber-board rose by a sizable 16.8%.

Pulpwood

Total receipts of pulpwood for January–March, 1960, were 10,413,000 cords, an increase of 1,237,000 cords over receipts for the comparable period last year. Domestic receipts were 1,146,000 cords above the year earlier total, and imports increased 91,000 cords. All of the regions showed increases ranging from 9% in the South Central to 20% in the West.

Pulpwood consumption for January–March, 1960, was 10,160,000 cords, an increase of 798,000 cords over the same period of 1959. All of the regions showed increases ranging from 4% Northeast to 20% North Central.

Inventories of pulpwood at the end of March were 5,424,000 cords, a decrease of 58,000 cords below February 1960, and a 312,000 cord decline from March, 1959. All of the regions showed decreases ranging from 1% North Central to 12% Northeast.

Waste Paper and Other Fibrous Materials

March wastepaper receipts were 775,000 tons; for the first three months of this year they totaled 2,337,000 tons; an increase of 106,000 tons above receipts for last year.

Wastepaper consumption for March was 778,000 tons, the January–March total was 2,273,000 tons, an increase of 20,000 tons above consumption for the same period last year.

Inventories at the end of March were 552,000 tons, a decrease of 4000 tons below February, and an increase of 96,000 tons above inventories at the end of March, 1959.

Consumption of total fibrous materials for March was 874,000 tons; the January–March total was 2,533,000 tons, an increase of 21,000 tons above consumption for the comparable period last year.

Inventories of total fibrous materials at the end of March were 1,004,000 tons, 18,000 tons below February and 87,000 tons above inventories at the end of March, 1959.

Wood Pulp

Production of wood pulp for January–March, 1960, was 6,320,000 tons, an increase of 447,000 tons above the comparable 1959 total.

Wood pulp consumption in the manufacture of paper and board for January–March, 1960, was 6,532,000 tons, an increase of 500,000 tons above consumption for the same period last year.

Imports of wood pulp for January–March, 1960, were 594,182 tons, an increase of 2% above imports for last year. Imports from Canada for January–March, 1960, were 489,049 tons, an increase of 4% above the comparable period of 1959. Overseas imports for January–March, 1960, were 87,364 tons as compared to 110,151 tons for the same period last year.

Exports of wood pulp for January–March, 1960, were 214,711 tons, as against 143,914 tons exported during the same period last year.

Inventories of wood pulp at paper and board mills at the end of March were 503,997 tons, a decrease of 1000 tons below inventories at the end of February and 42,000 tons below inventories at the end of March, 1959.

Overseas

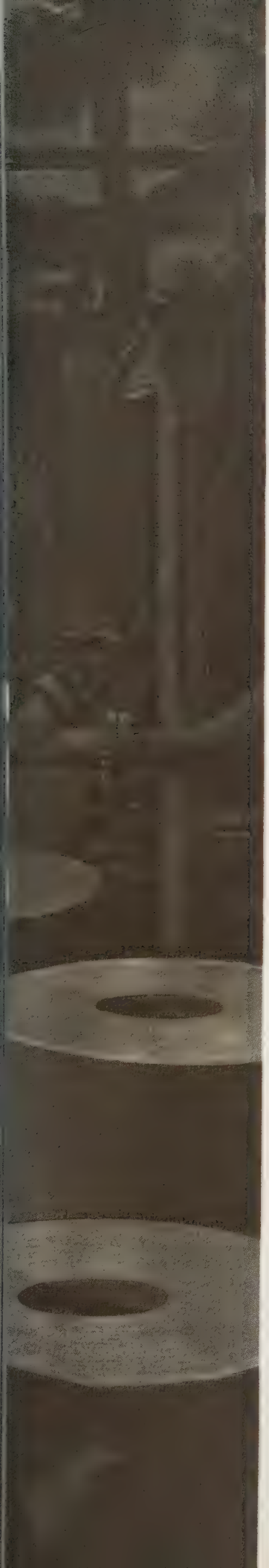
Japan

Clupak Paper to be Produced

Three of Japan's largest kraft paper companies, Chuetsu Pulp Industry Co., Ltd., of Tokyo, Daishowa Paper Mfg. Co., Ltd., Tokyo, and Tokai Pulp Co., Ltd., of Shizuoka Prefacture, have signed agreements with Clupak, Inc., to make Clupak extensible paper.

This brings to 15 the number of major domestic and foreign companies now licensed by Clupak, Inc., to manufacture Clupak extensible paper under its specifications: nine domestic, two Canadian, and one Swedish. In addition, the Clu-

[a] American Paper and Pulp Assoc., Monthly Statistical Summary, 38, No. 6 (June, 1960).



Walt Parker, who can duplicate and study virtually every pulping problem in a specially equipped laboratory, says you'll like doing business with Columbia-Southern

In the Pulp Laboratory at Columbia-Southern's Barberton, Ohio, Research Center, Walt Parker and his colleagues set up the full range of chemical situations encountered in commercial pulp mills. Thus they can study at first hand any particular questions important to mills using Columbia-Southern chemicals. Evaluation of customer formulations and methods have led to major savings and boosts in efficiency for a large number of pulp and paper producers.

When analyzing customer problems, the Pulp Laboratory engineers work closely with customer technical personnel, carefully checking every step along the way. This relationship insures *practical* results when the findings of the laboratory are put into operation in the customer's mill.

Concern that customers are getting the most efficient use of Columbia-Southern products is a principle followed throughout all departments. It is very evident in the regular activity of the Technical Service Engineers, for example, who provide consultation on unloading, storing, and handling potentially dangerous chemicals such as chlorine and caustic —to mention just one area of Technical Service responsibility.

Customer-oriented concern all along the line explains why so many leading organizations, representing all manufacturing industries, rely on Columbia-Southern for their basic chemical needs.

Anhydrous Ammonia, Barium Chemicals, Benzene Hexachloride, Calcium Chloride, Calcium Hypochlorite (Pittchlor®, Pittabs®), Carbon Tetrachloride, Caustic Potash, Caustic Soda, Chlorine, Chlorinated Benzenes, Chloro IPC, Chrome Chemicals, Hydrogen Peroxide, Muriatic Acid, Pacific Crystals, Perchlorethylene, Rubber Pigments (Calcene®, Hi-Sil®, Silene®), Soda Ash, Sodium Bicarbonate, Sodium Sulfate, Titanium Tetrachloride, Trichlorethylene

columbia | southern chemicals

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In Canada: Standard Chemical Limited, Montreal

pak trademark is registered in more than 50 countries and patent rights perfected in 35 countries.

The extensible machinery for the paper that has proved in wide usage to be exceptionally suitable for multiwall sacks, grocery bags, and many converting end-uses will probably be made in Japan by Mitsubishi Heavy Industries, Reorganised, Ltd. The three companies will produce kraft papers on 136-, 145-, and 92-in. machines, with an annual capacity of 70,000 tons. It is expected that production by all three licensees will start by Jan. 1, 1961.

ECAFE Conference on Pulp and Paper Industry

The problems of developing a larger pulp and paper industry in the countries of Asia and the Far East will be considered later this year at a United Nations conference to be held in Tokyo from October 17 to 31.

The conference, sponsored by the UN Economic Commission for Asia and the Far East (ECAFE), the UN Bureau of Technical Assistance Operations and the Food and Agriculture Organization, will concentrate on how best to overcome some of the obstacles now impeding the setting up of economically sound paper mills in the region where paper consumption is far below the world average.

Despite recent improvement, pulp and paper consumption in the Far East (excluding Japan, Mainland China, and Oceania) is still lower than in any major region in the world, the sponsors of the conference point out. The average yearly consumption of less than one and a half kg. (approx. 3.3 lb.) per inhabitant, compares to a world average of 22 kg. In the countries of Europe and North America the average consumption is 40 to 175 kg.

Even with low consumption, the region has always been a net importer of pulp and its products. In 1958, Asian countries are reported to have imported pulp, paper, wastepaper and paperboard, costing an estimated $200 million. Moreover, consumption of paper and paperboard is expected to approximately double during the next ten years because of expected population increases and hoped-for literacy improvement, together with an expanded economic growth rate. This means that if local production of pulp and its products is not raised considerably, there will be a heavy increased burden on currency available for imports.

However, the region's resources in papermaking materials are extensive and varied. Forests cover about 530 million hectares, or about a fifth of the total land area, even though there is a smaller area of forest per inhabitant than in most other major regions. Moreover, the uneven distribution of forest resources in the region and the relative shortage of forests in some areas has led to the widespread use of nontraditional fibers. No other region makes such extensive use of so varied a range of nonwood fibers, such as bamboo, rice straw, various reeds and grasses and bagasse, and one of the tasks of the meeting will be to compare the merits of further exploiting these resources and of establishing plantations of fast-growing species or making use of the natural tropical forests.

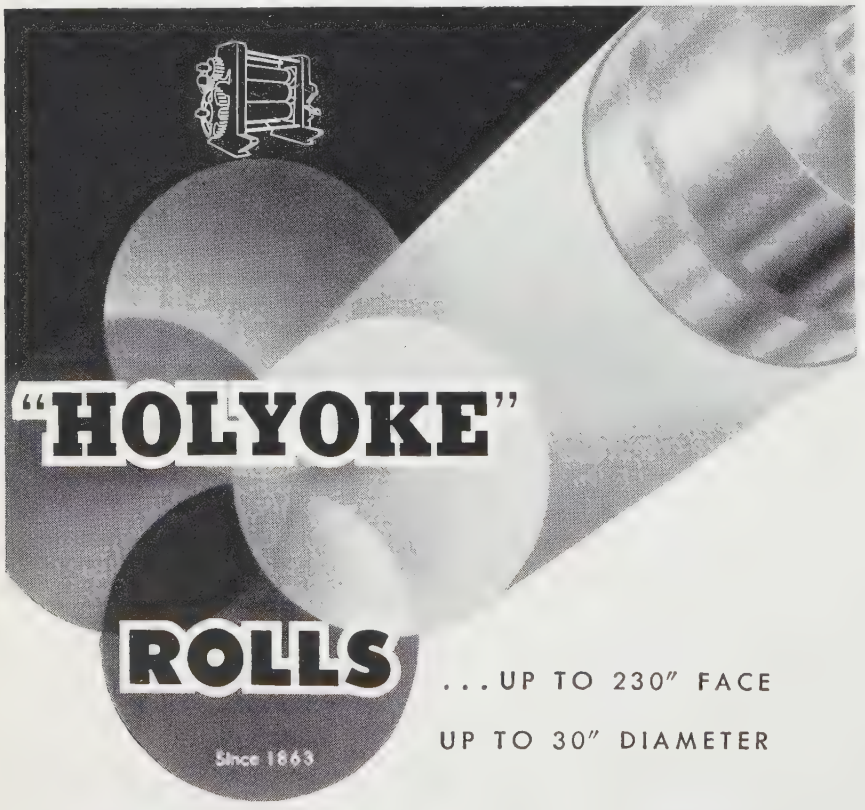
West Germany

Paper Still Leads Packaging Materials

Despite surprising advance of new packages and packaging materials, the fears that paper and paperboard would be put to a disadvantage in Germany have not come true, according to *Die Neue Verpackung* (West Germany). Latest statistics (1958) for Federal Germany show that about 50% of total package sales were of paper and paperboard. Though the growth rate was not quite so high as for plastics, says *Verpackung*, paper has certain advantages for distribution of goods, self service, fractional pack, and other purposes. "Instead of expected competition between paper and plastics, in many caseas 'matrimonia lalliance' has taken place," the article stated, in dicating a trend to many combinations of the two materials.

Standard procdeures for testing the water-repellent properties of solid fiberboard are being proposed in Germany, based on the TAPPI Routine Control Method RC-212. Heretofore, according to *Verpackung*, there has been no generally recognized procedure in Germany.

The March issue of *Verpackung* also contains an eightpage technical article on new uses for glass filaments bonded to papers, films, and fabrics, pointing out applications for heavy-duty shipping sacks and wrappings.



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CALENDER, EMBOSSING, FILLED and METAL ROLLS for INDUSTRY
WATER FILTRATION EQUIPMENT

Paper Manufacturers and Converting

Allied Paper Corp.

Dailey named Sr. Vice-President

J. D. Dailey has been named senior vice-president of Allied Paper. Former mill manager of Riegel Paper Corp., Wilmington, N. C., Mr. Dailey brings over thirty years of pulp and paper mill experience to Allied.

Allied Acquires Carmax

Acquisition of the Carmax Corp. of Houston, Tex., manufacturer of businees forms as a wholly owned subsidiary of the Allied Paper Corp. was announced recently.

Last April, Allied acquired the Egry Register Co. of Dayton, Ohio, the Stephen Greene Co. of Philadelphia, Pa., and the American Register Co. of Boston, Mass. With the acquisition of Carmax it is estimated that the four units will have a sales volume in business forms of approximately $12,000,000.

Bowaters Southern Paper Corp.

New Paper Mill at Catawba, S. C.

Financing has been completed and engineering begun for the installation of a paper machine beside the Bowaters Carolina Corp. pulp mill at Catawba, S. C.

The machine will be designed to produce 75,000 tons of printing paper per year, and is expected to come into operation at Catawba in 1962, according to T. C. Bannister, vice-president and general manager of Bowaters Carolina.

Brown Co.

G. F. Henderson Completes 43 Years' Service

Gilford F. Henderson of Watertown, Mass., general sales manager of Brown Co.'s paper and paper products division, will retire on August 1 after 43 years of service with the northern New England pulp, paper, and forest products firm.

Mr. Henderson, who was born in Portland, Me., where he attended Gray's Business College, joined Brown Co. in 1917 as order clerk and became manager, paper sales division, in 1936. In 1945 he was appointed sales manager, paper and paper towel division, and held this position until 1954 when the two divisions were split.

Widely known in the paper industry, Mr. Henderson served as president of the Kraft Paper Association in 1949–50, and at the same time, as chairman of the Bleached Converting Division, Sulfite Paper Manufacturers Association. He has also represented the Kraft Paper Association on the Board of Governors of the American Paper and Pulp Association.

During World War II, Mr. Henderson was an industry representative on the War Production Board and with the Office of Price Administration. He also served on the Kraft, Sulfite and Tissue Committee of the N.R.A. during the depression years in the 1930's.

Mr. Henderson is married and has one son Norman, also with Brown Co.'s sales department in Chicago.

Great Northern Paper Co.

Appointment

David F. Pollard, of Millinocket, has been appointed to the position of assistant manager of manufacture.

Mr. Pollard joined the company in April, 1947, and has held positions as assistant superintendent and superintendent of bureau of tests, assistant technical director, technical director, and has been production superintendent at the East Millinocket mill since April, 1958.

Hammermill Paper Co.

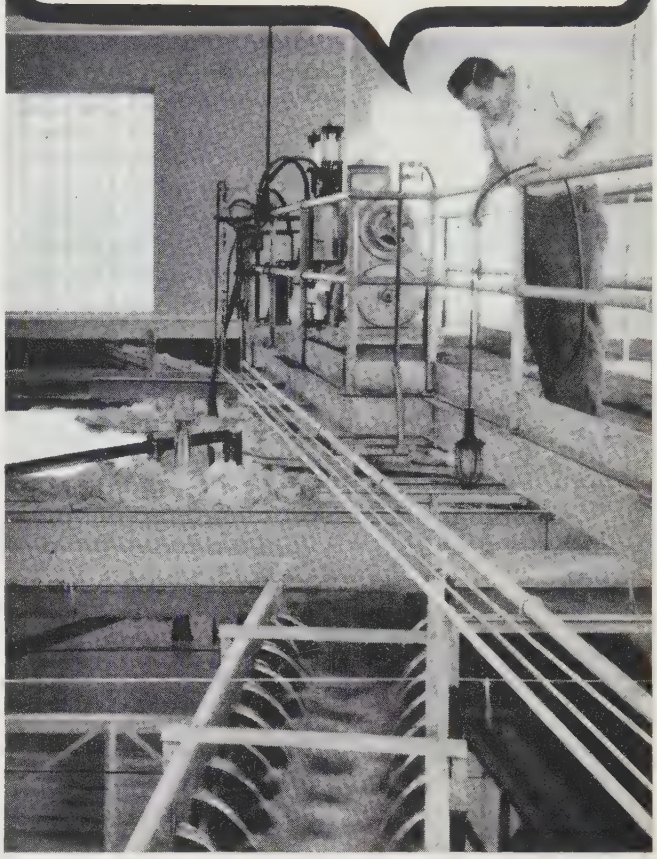
Old Colony Envelope Purchased

Donald S. Leslie, president of Hammermill Paper Co., announced that Hammermill has purchased a controlling stock interest in the Old Colony Envelope Co. from the Strathmore Paper Co. Strathmore Paper continues to hold an important minority interest in Old Colony.

The Old Colony Envelope Co. will continue to operate under its well-known present name. The present management headed by J. A. Chadbourne, president of Old Colony, will be retained and the present sales, purchasing and management policies continued.

Old Colony has been a leading envelope manufacturer for a quarter of a century with a large modern plant located in

N-SOL coagulant aid reduces raw water color to low 4/ppm



Consolidated Water Power & Paper Co.

This mill treats 10,000,000 gallons of raw water with color at 90/ppm by using 7/ppm of N-Sol coagulant aid (activated silica)*.

The color of the finished water is a low 4/ppm.

N-Sol and coagulant form a large heavy floc, which enmeshes impurities and suspended matter. The result is clean, clear water.

Besides this better quality water, the silica sol treatment cuts the settling time in half.

Ask for samples of N Silicate and reactant for jar test in your mill.

**N-Sol activated silica is prepared from N sodium silicate (41° Baume; 8.9% Na_2O, 28.7% SiO_2) and a reacting chemical.*

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PQ SOLUBLE SILICATES

Associates: *Philadelphia Quartz Co. of Calif. Berkeley & Los Angeles, Calif.; Tacoma, Wash.; National Silicates Limited, Toronto & Valleyfield, Canada.* Trademarks Reg. U.S. Pat. Off.

PQ PLANTS: ANDERSON, IND.; BALTIMORE, MD.; BUFFALO, N.Y.; CHESTER, PA.; JEFFERSONVILLE, IND.; KANSAS CITY, KANS.; RAHWAY, N.J.; ST. LOUIS, MO.; UTICA, ILL.

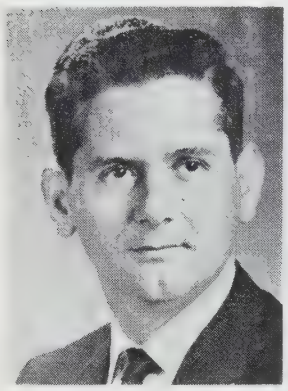
Westfield, Mass. Annual sales are approximately $6,000,000 made primarily to independent paper merchants located in all major markets of this country. Productive capacity to service paper merchants will be increased as quickly as possible.

Finch, Pruyn and Co., Inc.

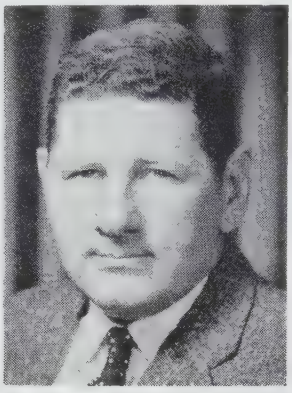
Appointment

Guenter Herwig has been appointed technical director of Finch, Pruyn in Glens Falls, N. Y.

Born in Nuremburg, Germany, Mr. Herwig was graduated from the O. V. Miller Polytechnic Institute in Munich. After serving as project engineer for pulp and paper mills in Europe, he joined Finch, Pruyn in 1955 as a technician in the development laboratory. He was promoted to development engineer in 1958.



Morton Hackor, Huyck Felt. Co.



Guenter Herwig, Finch, Pruyn & Co.

Huyck Felt Co., Div. of Huyck Corp.

Morton Hacker has joined the research and development department as research engineer. He will work primarily on the development of needled felts for the papermaking industry.

KVP Sutherland Paper Co.

New Laboratory Appointments

James F. Helmer has been appointed as a process engineer with the technical department and Richard C. Schultz to the quality control section of the technical department of the KVP Division.

Menasha Pulp and Paper Div., Menasha Wooden Ware Corp.

Pulp and Paper Mill for Oregon

A multimillion dollar pulp and paper mill will be constructed at North Bend, Ore., for Menasha Pulp and Paper Division of the Menasha Wooden Ware Corp., Menasha, Wis., by the Rust Engineering Co., Pittsburgh, Pa. Project supervision and design are being handled by Rust's office in Birmingham, Ala.

The Corp. has a plywood plant at North Bend, Ore., corrugated fiber box plants at Menasha, Wis.; Anaheim, Calif., Rockford, Ill.; and has a semichemical paper board mill at Otsego, Mich. The new pulp and paper mill at North Bend is scheduled for operation in the summer of 1961.

Oxford Paper Co.

OPC Lawrence, Mass.

William H. Chisholm, president of Oxford Paper Co., announced that as of June 30, 1960, Oxford Paper Co., Inc., Lawrence, Mass., will be operated as a division of the Oxford Paper Co., and this change in status will in no way affect either operations or personnel.

St. Regis Paper Co.

Appointment

Thomas Gerace has been appointed resident manager of the company's printing paper mill at Bucksport, Me. He replaces Fred C. Goodwill who has resigned from the company. Mr. Gerace has been serving as resident manager of the company's printing paper mill at Sartell, Minn.

J. P. Corbin, who has been assistant to the general manager of the Printing Paper Division, will replace Mr. Gerace as resident manager at the Sartell mill.

Benjamin C. Hoy has been appointed technical pulp sales representative in the Kraft Division. Mr. Hoy has been chief chemist at the North Western Pulp & Power Ltd. mill at Hinton, Alb., since its startup, in 1957.

Scott Paper Co.

Appointment

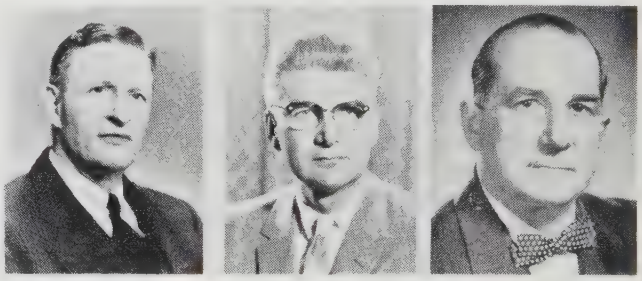
Forrest W. Brainerd, assistant vice-president of Scott Paper, has been selected for the newly created position of director of planning.

He will be responsible for giving leadership to Scott's long-range planning in all areas, and will report directly to James L. Madden, vice-president, who is chairman of the company's planning committee.

Westminster Paper Co., Ltd.

Appointments

John Ashby, executive vice-president of Westminster Paper, has announced the appointments of J. S. Gilham as



(Left to right) J. S. Gilham, C.N. Hagar, and M. A. Bailey, Westminster Paper Co., Ltd.

manager of technical services, fine papers; C. N. Hagar as plant manager, Crabtree Mills Division, and M. A. Bailey as assistant plant manager, Crabtree Mills Division.

Wyomissing Paper Product Co.

Fisher V.-P. of Manufacturing

Charles J. Fisher has been elected vice-president of manufacturing by Wyomissing, a division of the Narrow Fabric Co. The promotion, which was effective June 6, was announced by Samuel R. Fry, president.

Educational Institutions

Western Michigan University

Twenty-five papermakers from all over the United States and Canada are participating in a three-week course on the "Principles and Practice of Coated Paper Manufacture," which began June 19 WMU.

Regular faculty members of Western's world-famed department of paper technology are conducting this program, which includes an intensive preparation in lectures, laboratory work, and field trips.

Front row, left to right: Ronald A. Johnsen, Per R. Berg-Johannessen, Merrill E. Boone: C. E. Winchell, Jr., Spencer B. Smith, James R. Piehler, Hal W. Short, and Maurice F. McGrath. Second row: J. W. Maxwell, John Kila, William A. Matson, Gary L. Bezalla, H. M. Vosmer, Dr. John Fanselow. Third row: Stanley C. Zink and George C. Graham. Fourth row: Harold S. Hurwitz, Ronald Morgan, Dr. A. H. Nadelman, Roderick A. Perkins, Edward T. Kane. Fifth row: William J. Shaughnessy, Leonard P. Sutton, Richard H. Bublitz, Raymond L. Janes. Sixth row: Norris O. Faggard, Dr. R. A. Diehm, Dr. Andreas von Koeppen, and E. W. Leaman.

Industry Suppliers

Bauer Bros Co.

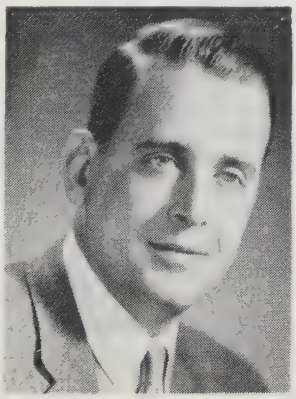
Appointments

Four new vice-presidents are included on a list of six executive appointments: These are Edward L. Rastatter, sales; James E. Irvine, engineering; Ronald G. Goodwin, pulping development, and Thomas T. Cowhey, general manager of The Bauer Bros. Co. (Canada), Ltd. Richard R. Dill was named manager of sales, industrial equipment, and Anton J. Horstman was appointed assistant to the administrative vice-president.

The Black-Clawson Co.

Landegger to Executive Vice-President

Carl C. Landegger has been appointed executive vice-president of B.-C. A vice-president of the company, he previously served in several management and administrative positions with divisions of the company. He is a director of Black-Clawson and has been active in the management of the Paper Machine Division in Watertown, N. Y., and the Shartle Division in Middletown, Ohio.



Carl C. Landegger, Black-Clawson Co.

Cellulose Australia, Ltd.

Black-Clawson Equipment Contract

The Black-Clawson Co. has been awarded the contract to supply an 8-cylinder paperboard machine and all of the necessary stock preparation equipment for an expansion program that will triple the producton of Cellulose Australia, Ltd., Millicent, South Australia, a major supplier to the Australian packaging industry, and the only manufacturer of paperboard in South Australia.

All of the machinery will be built by Black-Clawson International at its Newport plant in England. Following installation, the new equipment will increase production of the mill to 60,000 tons per year of container board grades.

John W. Bolton & Sons, Inc.
The Emerson Mfg. Co., Division

Winners of 13th Bolton Award

The ten winners in this year's 13th Bolton Award Essay contest were announced at the business meeting which opened the 41st Annual Convention of PIMA held at the St. Francis Hotel, San Francisco, Calif. The subject of the contest was "Through the Grapevine."

First prize of $1000 was won by Robert A. Bagg, mill visit host, Strathmore Paper Co., West Springfield, Mass. (Mr. Bagg was also a prize winner last year.) Second prize of $750 goes to James C. Lannen, personnel supervisor, Fraser Cos., Ltd., Atholville, N. B.; and the third prize was won by Clifton Joseph Walker, map draftsman, The E. B. Eddy Co., Hull, Que.

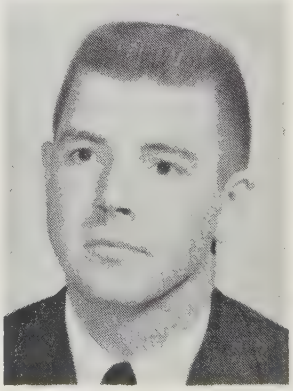
Seven other contestants won prizes of $200 each. They are: Robert E. Lee, Jr., quality control supervisor, Rochester Paper Co., Rochester, Mich.; C. H. Rausch, vice-president—manufacturing, Hennepin Paper Co., Little Falls, Minn.; Donald E. Reed, supervisor of stores, Continental Can Co., Elkhart, Ind.; M. S. Dimitri, research engineer, West Virginia Pulp and Paper Co. (Mr. Dimitri was a prize winner in both the 1957 and 1958 contests); Mrs. Joann Graham, secretary, Packaging Corp. of America, Central Fibre Division, Hutchinson, Kan.; Mrs. Helen Kalivoda, secretary for management personnel, Huss Ontonagon Pulp & Paper Co., Ontonagon, Mich.; and Robert L. Witham, plant guard, Grand Northern Paper Co., East Millinocket, Me.

World Market Expansion

The announcement of Bolton-Emerson S.A. as the foreign subsidiary of John W. Bolton & Sons, Inc., and The Emerson Mfg. Co., Div., Lawrence, Mass., manufacturer of stock preparation machinery and equipment, has been made by A. L. Bolton, Jr., treasurer and general manager.

Located at 18 Grand Pont, Lausanne, Switzerland, Bolton-Emerson S.A. is headquarters for the firm's international operations. Staffed to handle sales, engineering, the preparation of stock treatment proposals and product estimates, among other functions, the Swiss office directs sales to the pulp and paper industry throughout the world and operates in conjunction with the company's overseas sales agents.

John Mladota, Bolton-Emerson, S.A.



Lee H. Flanders, Bolton-Emerson

John Mladota is president and managing director of the foreign subsidiary. A graduate of the University of Prague, Mr. Mladota has a broad business background both in America and Europe.

Appointment

Lee H. Flanders has been appointed a sales representative of J. W. B. Mr. Flanders will cover the California territory and will make his residence at 3711 Fruitvale Ave., Oakland 2, Calif.

Columbia Corrugated Container Corp.

Expansion

Columbia Corrugated of Hicksville, L. I., N. Y., will double its present manufacturing capacity by building a new plant in Syosset, Town of Oyster Bay, L. I.

Upon completion, the new plant structure, 200,000 sq. ft. in area, will be the second-largest one-level building on Long Island, according to Paul Serwitz, president of Columbia. (The largest belongs to the Mergenthaler Linotyping Corp. in Oyster Bay.) The expansion will make Columbia the largest independent corrugated package manufacturer in the New York area.

Corn Products Co.

Starch for Enzyme Conversion

A new dustless high-density, flash-dried starch in granular form has been specially developed for the paper industry by Corn Products. Designated Globe Brand Easy-Enz No. 3387, the starch is specifically intended for enzyme conversion; according to Corn Products, the new coating and sizing starch offers five basic advantages: (1) It stores more compactly, (2) wets out quickly and converts completely with less enzyme, (3) is more uniform in particle size, moisture content, and pH, (4) reduces housekeeping costs, and (5) is easier to convert.

Corn Refining Division
Penick and Ford, Ltd., Inc.

Appointments

Three new vice presidents have been appointed to the Corn Refining Division of Penick & Ford. They are: J. E. Killinger, vice-president of technical sales service and field

(Left to right) J. E. Killinger, C. C. Kesler, S. H. Foster, Corn Regining Div.

development; C. C. Kesler, vice-president of research and development; and S. H. Foster, vice-president of production. All three men will make their headquarters at the Cedar Rapids, Iowa, plant.

Dyestuff and Chemical Div.
General Aniline & Film Corp.

Appointment

William G. Sumner has been promoted to the position of Sales Engineer at the Chattanooga, Tenn., branch office of Dyestuff and Chemical. He will be concerned with the application of the firm's chemicals in the textile, paper, and leather industries in that territory.

Eastern Fine Paper and Pulp Div.
Std. Pkg. Corp.

Appointment

Appointment of Edward W. Keith as superintendent of the sulfate pulp mill at the Lincoln, Me., mill of Eastern Fine Paper has been announced by Frank A. Knight, division manager. Mr. Keith's appointment was effective July 1.

Fibreboard Paper Products Corp.

Appointment

Leslie M. Spurgeon has been appointed technical director of the Paperboard Division of Fibreboard Paper Products Corp. Mr. Spurgeon has been with Fibreboard since 1953. Since 1958 he has served as Technical Superintendent at the Stockton Board Mill.

William H. Streaker, technical superintendent of the Vernon Board Mill, succeeds Mr. Spurgeon at Stockton. A. F. (Fred) Landsberg, Process Engineer, Vernon Board Mill has been promoted to take Mr. Streaker's place.

Fiber Products Research Center, Inc.

Appointments

Fiber Products, Beaver Falls, N. Y., has announced the appointment of three additions to its staff:

Allen F. Owen, formerly vice-president in charge of research and development, Latex Fiber Industries, Inc., to scientific advisor; George K. Boger, Jr., formerly technical director of Amalgamated Chemical Corp. to manager of engineering economics; William P. Kinlin, formerly with Osmose Wood Preserving Co., to research associate.

General Electric Co.

Paper Tension Control

Bulletin GET-2741-7A, on paper tension control, describes the operation of G.E.'s tension head and potentiometric recorder controller at various sections of paper machine. Discussed are applications and features of the system as used on lineshaft-driven machines. Specifications and illustrations are also included.

Hooker Chemical Corp.

Partridge Manager of Paper Industry Development

Harold D. Partridge has been appointed to the newly created position of manager of paper industry development for Hooker.

He will direct and coordinate Hooker's technical service and development activities covering the use of chlorine, caustic soda, sodium chlorate, and paper treatment for such pulp and paper processing operations as chlorine bleaching, chlorine dioxide bleaching and generation, pulping, sizing, and coating.

Harold D. Partridge, Hooker Chemical Corp.

I-T-E Circuit Breaker Co.

Jameson to Manager Buffalo Sales

William D. Jameson has been named manager of the Buffalo district sales office of I-T-E Circuit Breaker. He will handle sales of I-T-E electrical equipment in western New York and northwestern Pennsylvania.

The New Jersey Zinc Co.

Organizational Changes

The company has announced the following changes in its sales and purchasing organizations, effective July 1:

Robert W. Munson has been appointed southern district sales manager in charge of a new sales district, with headquarters in Atlanta.

Alfred Ohlander has been named Pacific district sales manager, with headquarters in Los Angeles.

Robert J. Delack, formerly pigment sales representative of the New York office, has been placed in charge of the sales office in Boston.

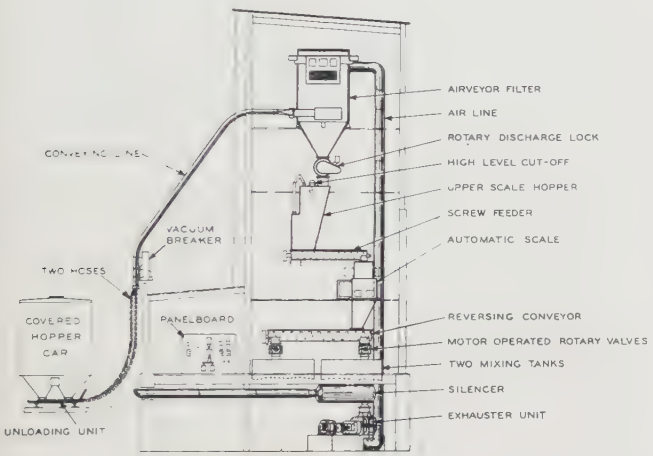
Frank A. Gilson has become a pigment sales representative, assigned to the New York Metropolitan area.

J. Stuart Collbran, Jr., has been appointed manager of purchasing with headquarters in New York. He succeeds W. C. Dunlap, who died on February 18.

New York & Pennsylvania Co.

Clay Handling Time Cut 65%

An automatic system built into a clay preparation tower enables one man at a master control to unload 25 tons of bulk clay an hour. Until recently the million 100 pounds a year of spray-dried predispersed clay used by New York & Pennsylvania Co. at its various mills was received at the Johnsonburg mill in bags, where it took four men a full day to unload one care of six hundred 100-lb. bags.



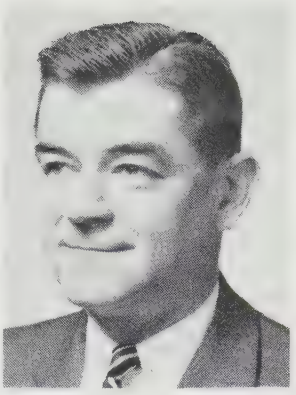
This new tower was built alongside a railroad siding (see illustration). Covered hopper cars, holding 50 tons of clay divided into two sections, pull up adjacent to this tower, a dual-feed unloader is attached to the enterprise gates at the bottom of the car, and after hooking up air and conveying line hoses to the car and the unit, and opening the car outlets, the operator starts a blower.

Material drops by gravity through the two gates directly into the unloader and then into a pneumatic vacuum system (designed and manufactured by Fuller Co., Catasauqua, Pa.) which sucks the clay 50 ft. up to a filter on the top floor of the preparation building. The filter separates the clay from the conveying air, which is piped to an exhauster to provide both the activating air and the vacuum for the entire system. Power requirement for the exhauster is 100 hp.

The Noble and Wood Machine Co.

Management Changes

The board of directors has announced the election of William H. Areson as president and chief executive officer of the company, effective July 1, 1960. He succeeds Harry N. Weir, chief executive of the company since 1945, who has become chairman of the board.



William H. Areson, Noble and Wood Machine Co.

Harry N. Weir, Noble and Wood Machine Co.

Four new members were also elected to the company's board of directors: they are William Pitt Mason, Jr., who will serve as vice-chairman; John S. Davison; George S. McKearin, Jr.; and John W. Robb, Jr.

Olin Mathieson Chemical Corp.

Appointments

Milton O. Schur has been named vice-president for research of the Packaging Division of Olin Mathieson. He was formerly director of research and development for the division's Ecusta Paper operation in Pisgah Forest, N. C., and will continue as consultant to Ecusta.

David C. Lea will replace Mr. Schur at Ecusta. He is director of research and development for the division's forest product operations in West Monroe, La.

Dr. Lea's position is to be taken by Thomas Zentner, director of research and development for the Gardner Division of Diamond National Corp., Middletown, Ohio.

Orr Felt & Blanket Co.

Appointment

Orr Felt, Piqua, Ohio, has announced the appointment of Bill Ginn as territorial representative in the West Central territory. This includes Colorado, Iowa, Kansas, Missouri, Oklahoma, Southern Illinois, and Southern Indiana.

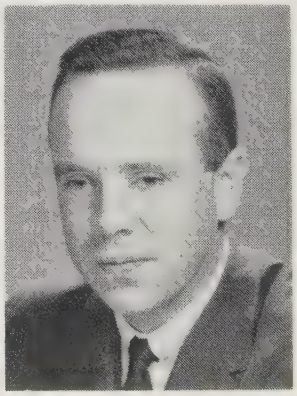
Porrits & Spencer (Canada), Ltd.

Waterbury Felt Acquired

The Waterbury Felt Co. of Skaneateles Falls, N. Y., has been acquired by Porritts & Spencer (Canada), Ltd., of Hamilton, Ont. Transfer of ownership was effective July 1, 1960.

Waterbury Felt now becomes a part of the international Porritts & Spencer organization, with head office in Bury, Lancashire, England, whose first mill was established in

Milton O. Schur, Olin Mathieson Chemical Corp.



Stephen J. Elkins, H. Waterbury & Sons Co.

1808, 152 years ago. The company is believed to be the largest manufacturer of mechanical cloths in the world, with six mills in England and one in Canada. The Waterbury mill will be the company's first in the United States.

The Waterbury Felt Co. was established in Skaneateles Falls in 1907 by Henry T. and D. Albert Waterbury and has continued in operation since that time under the guidance of members of the Waterbury family.

J. O. Ross Engineering
A Division of Midland-Ross Corp.

New Sales Office for Mobile

J. O. Ross recently announced plans for the opening of a new sales office in Mobile, Ala. R. C. MacDuffee will head the new office, the ninth in the Ross organization.

Promotions

Five promotions were announced recently by C. J. Schmidt, executive vice-president of the division.

Robert W. Grott, district manager of the Ross Seattle office, will go to the New York office as assistant chief engineer for the Division; Paul Goldner will replace Grott in the Seattle office; George Schuning, formerly a sales engineer in the Ross Chicago office, will become district manager of the Boston office; Dave Alexander, now a sales engineer in the Boston office, will be assigned to paper mill sales territories in the New York office; and Ken Jones, in charge of paper mill sales in the New York office, has been made district sales manager.

Shuler and Benninghofen

Thompson Promoted

Paul W. Thompson has been appointed national sales manager for Hamilton Felts. He has been associated with the company for many years in sales and service, and is well known to the paper industry in the Midwest for his development of paper machine clothing.

J. E. Surrine Co.

Meakin Elected Vice-President

H. Wells Meakin has been elected vice-president in charge of the Pulp and Paper Division of J. E. Sirrine Co., Greenville, S. C., Mr. Meakin has been on the staff of Sirrine since 1928. He is an active member of TAPPI and a registered professional engineer.

Traylor Engineering and Mfg. Div. of Fuller Co.

Company's New Office

The San Francisco office of the company moved into the Fuller offices there on June 10. Channing O. Davis, Traylor president, announced that the firm's offices in San Francisco now are at 617 Chancery Building, 564 Market St.

Edward B. Greef, district manager for the office, is in charge of sales in California, Nevada, Arizona, and New Mexico.

H. Waterbury & Sons Co.

Appointment

Stephen J. Elkins has been appointed sales representative for New York State and Northeastern New Jersey.

General

Bowen Laboratory Spray Drier

Instant Emulsions Through Spray Drying

Spray drying is playing an important role in the research efforts at the Research Laboratories of the National Cash Register Co. Since the introduction early in 1954 of NCR Paper—"No Carbon Required"—National Cash has been studying the feasibility of drying the colloidal emulsion which is coated on the back of the business forms in the belief that

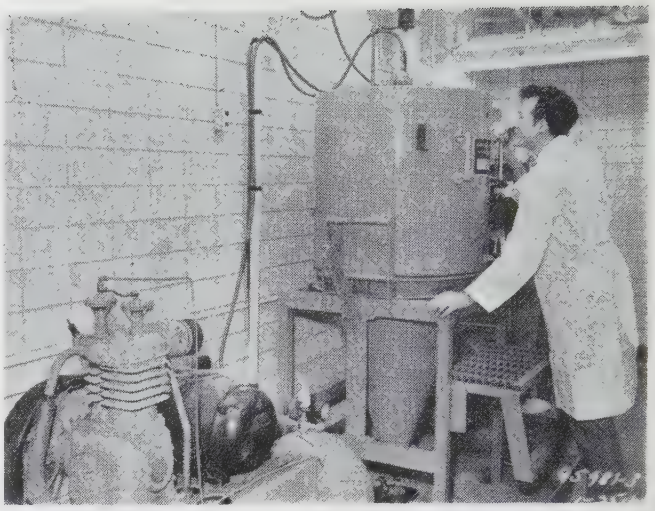


Fig. 1. Material fed into the Bowen spray drier is checked through porthole which also enables the rapid desiccation of feed to be observed

such drying might improve even further the functional qualities of the emulsion and economize on the shipment of the chemically reactive substance.

The ultimate introduction of the carbonless paper was the culmination of 15 years of concentrated research in the coating of paper with colorless dye materials which, when brought into contact with ordinary paper, clothing or skin, produce no color, yet, when brought into contact with a reactive clay formulation, create immediate, intense color. Thus, when a top sheet is impressed by typewriter, pencil, etc., copies are made without carbons. The pressure breaks the encapsulated dye-oil material sheets.

The capsules cannot be seen by the naked eye, nor can they be felt, except as a "grainyness." Nor can the clay coating be seen or felt, for all of it is fine-ground to 10 μ or less, and the greater portion is pulverized to less than 5 μ.

Once the problems of application and dye transfer were solved, NCR began working on the drying of the heat-sensitive dye-oil colloidal suspensions; in effect, it began seeking "instant emulsions."

The spray drier being used in this NCR research at Dayton is a laboratory unit engineered by Bowen Engineering Inc., North Branch, N. J. Various colloidal dispersions are fed

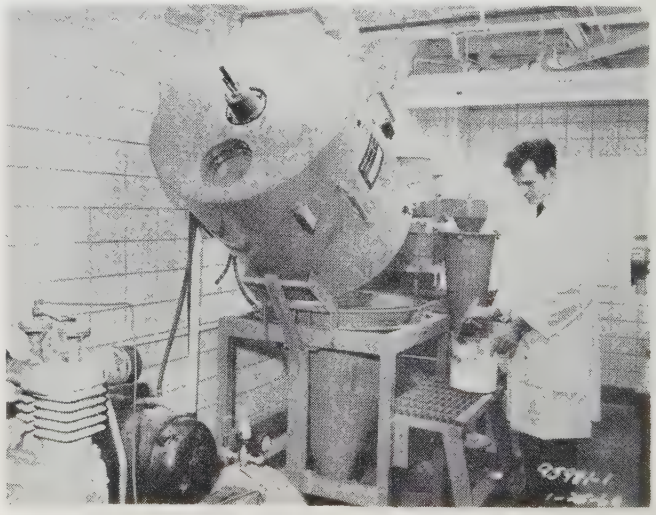


Fig. 2. Drier is quickly and easily accessible for cleaning and maintenance. Here, opened on a hinge, both cylindrical drying chamber and conical bottom are visible. At right is cyclone collector which feeds spherical particles into Pyrex collector.

to the drier via an atomizing device located in the center of a vaned inlet through which heated air forces it into a whirling vortex. Hot, turbulent air currents evaporate the liquids and instantly transform the solids into powder, and the dried product and air pass from the chamber through a duct to a cyclone collector where the solids are removed from the air stream. The air is exhausted into the atmosphere. Total treatment time from liquid to solids is several seconds. The temperature of the collected solids is approximately that of the outlet-air, wet bulb temperature. When necessary, materials having exceptionally low deterioration points or extreme volatility are shock-cooled by air admitted through Bowen-patented cooling inlets in the side wall of the drying chamber.

The Bowen Drier

The production capacity of the Bowen drier at the NCR laboratories varies with the feed, its concentration, and the experiment under way, as well as other factors. Drying air rate is 250 c.f.m., equivalent to approximately 15 lb. per min. at low temperatures and 12 lb. per min. at high temperatures. Heat load varies from 50,000 to 230,000 B.t.u. per hr. with a water evaporation rate of 15 to 60 lb. per hr.

Concurrently, stainless steel dual-fluid nozzles introduce the feed, as it enters the double-walled insulated cylindrical drying chamber, in a foglike mist, the slurry undergoes rapid desiccation. It is discharged seconds later from the conical-bottom as dried spherical particles. The drying action may be observed through small ports in the cylindrical portion of the chamber.

The cylindrical drier chamber is hinged at the junction of the conical section, allowing ready access to all interior surfaces for ease of cleaning and maintenance. Even the flanged and gasketed ductwork is assembled with wingnuts and bolts for ease of cleaning.

The Bowen unit is an "on call" research unit, at the service of any department of the company. Although it is used only to investigate the action of spray-dried materials for diverse company projects and not for production drying, it could be adapted to limited-capacity production operations. The Bowen laboratory unit is used in such a capacity in industrial applications, particularly in the ceramics industry.

The laboratory spray drier is only one of a series of sizes and capacities made available by Bowen Engineering. Custom research on all sizes of driers is conducted at Bowen's extensive North Branch laboratories.

FPBAA Mechanical Cartoning Equipment Manual

Thirty-four new and revised data pages for the "FPBAA Mechanical Cartoning Equipment Manual" have been distributed to manual owners by the Folding Paper Box Association of America. A valuable reference for the automatic setup and filling of folding cartons, the book is now available to anyone interested in mechanical cartoning equipment.

The book is a loose-leaf manual into which additional pages can be inserted as they are made available by the publisher. New additions to the book include data on machinery manufactured by the following: The International Paper Box Machine Co., Nashua, N. H.; Peters Machinery Co., Chicago, Ill.; Alford Package Machines, Inc., Ridgefield Park, N. J.; U. S. Automatic Box Machinery Co., Inc., Boston, Mass.; Container Equipment Corp., Bloomfield, N. J.; Food Machinery and Chemical Corp., Canning Machinery Division, Hoopeston, Ill., and San Jose, Calif.; R. A. Jones & Co., Inc., Covington, Ky.; F. B. Redington Co., Bellwood, Ill., and the Triangle Package Machinery Co., Chicago, Ill.

Specific machines for which data pages are included in the manual are classified according to the basic carton style that is handled on each machine—tray styles, tube styles, and specialty styles. Each major equipment group is further subdivided into sections for each of the specific types of machines included in the group.

The FPBAA headquarters, 222 W. Adams St., Chicago, handles distribution of the manual.

Corrosion Resistance of Polyester Resins

Tests under way at Atlas Powder Co., have shown that wide differences exist in the corrosion resistance properties of the various polyester resins. Castings and laminates made from three different polyester resins—bisphenol A, isophthalic, and general-purpose—were immersed in eight corrosive aqueous solutions for periods ranging from 24 hr. to 90 days and changes in physical properties were noted. The corrosive media were: distilled water, 5% sodium hydroxide, 5% nitric acid, 25% sulfuric acid, 15% hydrochloric acid, 25% acetic acid, Clorox, and 5% Electrosol (a commercial dishwashing detergent).

One significant finding was the inapplicability of a fast screening technique as an index of corrosion resistance. In the screening trial, castings made from the three resins were subjected to boiling sulfuric acid, distilled water, and sodium hydroxide for 24 hr. It was found that although a resin may withstand the screening test satisfactorily, it would not hold up under longer immersion periods. For example, the isophthalic resin, which appeared satisfactory after a 24-hour boil in the sodium hydroxide solution, deteriorated completely after 30 days at 210°F. After the 90-day exposure test, none of the bisphenol A polyester samples deteriorated appreciably,

PER CENT OF FLEXURAL STRENGTH RETENTION OF POLYESTER CASTINGS

		Dist. H_2O	25% H_2SO_4	5% NaOH	5% HNO_3	15% HCl	25% AcOH	5% Electrosol	Clorox
Screening Test Trial 24-Hour Boil	Bisphenol A	81	91	84					
	Isophthalic	74	108	106	← NOT TESTED →				
	Gen. Purp.	47	68	+14					
30-Day Immersion @ 210°F	Bisphenol A	56	66	71	66	59	74	76	70
	Isophthalic	29	72	Dissolved	41	32	19	42	89
	Gen. Purp.	+16	41	Dissolved	+12	+10	+9	+13	+15
90-Day Immersion @ 210°F	Bisphenol A	60	62	59	40	75	71	50	51
	Isophthalic	+18	73	Dissolved	+14	+20	+9	0	52
	Gen. Purp.	+13	Deteriorated	Dissolved	Deteriorated	+7	+7	Deteriorated	+14

with the exception of the casting immersed in nitric acid. The general-purpose polyester resin was seriously affected or was completely deteriorated by all of the corrosive media. All isophthalic specimens suffered serious or complete deterioration, except for those immersed in sulfuric acid and Clorox solutions. Electrosol, a very strong dishwashing detergent, completely degraded both the isophthalic and general-type purpose polyesters after 30 days' immersion. Bisphenol A polyester retained 50% of its original flexural strength after 90 days.

Sodium hydroxide attacked both the general-purpose and the isophthalic polyesters, and both lost all of their original flex strength before the end of a 30-day test period. Bisphenol A polyester, however, retained almost 60% of its original flexural strength after 3 months of exposure at 210°F.

A copy of the complete report and subsequent reports on longer exposures can be obtained, free of charge, from the Plastics Marketing Section, Atlas Powder Co., Wilmington 99, Del.

Radioisotope Particle Size Analyzer

A new instrumental technique for automatic particle-size analysis was reported before the sixth annual meeting of the American Nuclear Society, Chicago, Ill., by Dr. Jane Connor of Evans Research and Development Corp., New York City.

The theory of the Evans Research radioisotope, automatic particle analyzer is based on a beta-ray, back scattering technique which measures the magnitude of fluctuations or the "spread" in a random sampling operation under specific geometrical conditions. Its source of radiation is carbon 14. Its sensitivity range is from 1 to 500 μ and data are provided in a matter of minutes. This instrumental approach has applications to any situation in which dispersions of fine droplets or solid particles are produced.

Color Plates for $CaCO_3$ Brightness

The Pulverized Limestone Association has developed color plates in the brightness range of 94 to 96. The color values were determined at 550 wavelength on the G.E. spectrophotometer. These plates were made by Corning Glass from thermometer white glass. They are usable with G.E. spectrophotometer, Hunter reflectometer, the Colormaster, and were developed primarily for measuring the brightness of calcium carbonate. These plates are available for loan.

Information may be obtained by writing to any member of the Pulverized Limestone Association or to A. B. Miner, National Gypsum Co., 325 Delaware Ave., Buffalo 2, N. Y.

Translations

English translations of the following articles will shortly be available at the rate of $^1/_3d$ (≈$0.18) per page from The British Paper and Board Makers' Association (Inc.), St. Winifred's, Welcomes Road, Kenley, Surrey, England: "Fourdrinier Wires from Plastics," by M. Weinfurt and M. Chromy, *Papir a Cellulosa* 14, (1): 7–9 (1958).

"Sizing Paper with a Mixture of Rosin Size and Sulfite Liquor Waste," by V. N. S. Kolov, *Bumazh Prom* 34, 12: 16 (1959).

OBITUARIES

John W. Benninghofen

John W. Benninghofen, 47, an active partner of S&B, died June 1 of a heart attack in Hershey, Pa., where he had been taking a short vacation.

Mr. Benninghofen was a fourth generation Benninghofen, and was named for his great grandfather, who, with Asa Shuler, founded the Hamilton firm in 1858.

Lewis G. S. Hebbs

Lewis G. S. Hebbs died suddenly at his home, May 14, 1960.

Mr. Hebbs, who was born Jan. 2, 1905, in London, was associated with the well-known firm of Cross & Bevan since 1922 where he started as a laboratory assistant. He received his A.I.C. degree in 1935 from The Polytechnic in London. In 1930 Mr. Hebbs was made a partner and in the intervening years traveled extensively in Europe and America as a consultant on pulp and rayon manufacture.

Mr. Hebbs became a member of the Technical Association of the Pulp and Paper Industry in 1937.

E. Clinton Bowen

E. Clinton Bowen died unexpectedly June 20, 1960, at his home at the age of 53.

He graduated from Northeastern University in 1928 with a Bachelor's Degree in Chemical Engineering. He also did graduate work at Massachusetts Institute of Technology in spectroscopy and electronics.

He was President of The Bowen Corp., a general engineering firm. Among the company's major achievements was the application of vapor compression distillation to industrial waste recovery.

Mr. Bowen was a member of the Technical Section of the Canadian Pulp and Paper Association, a member of TAPPI, and for several years served as secretary of the TAPPI Chemical Engineering Committee. He was also chairman of the subcommittee on committee liaison. His early interest in operations research and systems engineering was instrumental in the establishment of the present subcommittee on Operation Research.

Mr. Bowen was a member of the Pulp and Paper Foundation of the University of Maine.

As a member of the A.I.Ch.E., in December, 1956, Mr. Bowen was chairman of a symposium on Chemical Engineering in the Pulp and Paper Industry held in Boston during the forth-ninth annual meeting of A.I.Ch.E. As a result of his work the program committee of A.I.Ch.E. became interested in the pulp and paper industry and ever since has had an annual symposium devoted to chemical engineering in that field.

L. T. Sandborn

Lloyd Thompson Sandborn, aged 60, assistant research director for the Crossett Co., died June 7, 1960, at his home.

Dr. Sandborn worked for The Crossett Co. for 14 years and was best known among his colleagues for the obtaining of vanillin from pulping by-products.

He was born at Appleton, Wis., and received his bachelor of arts degree from Lawrence College and his master of arts and doctor of philosophy degrees from the University of Illinois. He was a member of Phi Beta Kappa and Sigma Xi. He was a chemist for E. I. du Pont de Nemours & Co. at Wilmington, Del., three years and worked for Marathon Corp. at Wausau, Wis., from 1929 to 1946.

He was past president of the South Arkansas Section of the American Chemical Society, a member of the Technical Association of the Pulp and Paper Industries, a member of the Forest Products Research Society, a Rotarian, and a Mason. Dr. Sandborn was a Methodist and taught a men's Bible class eight years.

Survivors include his wife; two daughters, Mrs. Joe Dean Goddard of Fort Worth, Texas, and Mrs. Charles Pate of Dallas; a sister, Miss Ruth Ellen Sandborn of Providence, R. I., and a grandson.

George S. Hammer

George S. Hammer passed away on June 24, 1960, at the age of 55. Mr. Hammer was associated for 36 years with Forbes Lithograph Manufacturing Co., Boston, most recently as Director of Technical Services. The major part of his career was devoted to the achievement of high-quality printed color reproductions. In this connection he investigated the properties of paper, and co-authored "Paper Moisture Balance in Lithography," published in the 1954 Proceedings of the Technical Association of the Graphic Arts. As a result, paper industry practices in the storage and packaging of paper for lithographic printing have been modified.

In addition to being a member of TAPPI, Mr. Hammer belonged to the Lithographic Technical Foundation, the International Association of Printing House Craftsmen, and the Boston Litho Club. He was a founding member of the Technical Association of the Graphic Arts, served two terms as secretary-treasurer, and one as a director. Mr. Hammer was often invited to speak at national trade association meetings such as the October, 1959, convention of the Gravure Technical Association.

He made his home at Marblehead, Mass., where he took an active interest in St. Stephen's Methodist Church as a member of the board of trustees and chairman of the building committee. The church has established a memorial to this "devoted and dedicated layman." He is survived by his wife, Miriam, daughter, Miss Maxine Hammer, and son, Donald Hammer, five brothers, two sisters and three grandchildren.

TAPPI DIVISIONS AND COMMITTEES

Reports of Activities

Converting and Consuming Division

Plastics Laminates Committee

The Plastics Laminates Committee of the Converting and Consuming Division met at the Hotel Commodore, New York, N. Y., on Monday, Feb. 22, 1960, during the annual National TAPPI meeting. The meeting was called to order by H. A. Spencer, chairman.

The first order of business was election of officers for the coming year. A nominating committee composed of P. M. Goodloe, Brown Co., chairman, C. Elmer, Monsanto Chemical Co., and W. E. Morris, Allied Chemical Corp. proposed the following slate of officers:

Chairman: R. H. Doughty, Fitchburg Paper Co.
Vice-Chairman: C. J. Seiler, Behr-Manning Co.
Secretary: D. M. Gilmore, Brown Co.
Associate Secretary: Miss G. L. Reidy, St. Regis Paper Co.

The committee unanimously approved the slate as nominated.

The various committee projects were discussed and reported:

Project 763—Rate of Penetration Test. Following Mr. Gilmore's paper at the Fourteenth Paper Conference in Chicago, Ill., it was agreed that the results indicated a need for refinement of the method prior to further test work. H. A. Spencer, Knowlton Brothers, agreed to investigate the matter with the Williams Instrument Co., manufacturer of the Williams penetrometer used in the round-robin test. Mr. Spencer reported that work was progressing on modifications to the instrument to provide an electrically determined end point. Present plans are to modify one instrument which can then be circulated among a number of laboratories for evaluation. Mr. Spencer advised that the additional equipment should cost approximately $50. Mr. Gilmore will continue analysis of the data from the round-robin test and it is anticipated that a final report on the project will be given at the 1960 Plastic-Paper Conference in Syracuse, N. Y., in October.

Meeting of Plastics Laminates Committee, Hotel Commodore, New York, N. Y., Feb. 22, 1960

Project 764—Determination of Resin Solids in Laminates. C. A. Siconolfi, Durez Plastics Co., reported at the 1959 Plastics-Paper Conference on an extraction method using beta-naphthol. A round-robin test has been arranged and will be confined in the initial stages to phenolic materials. Melamine, epoxy, nylon, and silicone materials will be investigated at a later date. A report of a study of the Durez method versus the Knowlton Brothers' method was given and good agreement was obtained over several tests. Mr. Siconolfi expects to have the project completed in time for a report at the October meeting and round-robin extraction data available for discussion at the summer meeting of the Plastics-Laminates Committee in July or August.

Project 765—Resin Distribution Within the Saturated Sheet. C. J. Seiler, subcommittee chairman, was not present. A literature search on staining techniques has been completed by Mr. Seiler and he expects that this will be published by TAPPI for distribution to committee members.

A general discussion took place regarding the scope and activity of the committee. It was agreed that in view of the growth of the industry a redefinition of the committee scope should be considered. It was proposed and accepted that "The Plastics Laminates Committee is to be concerned with pulp, paper, and/or other reinforcing materials which are impregnated with 5% or more of plastics or resins in the manufacture of laminates." It was agreed that the objective should remain that "The committee will be concerned with the development of standards and suggested methods for the evaluation of raw materials which enter into laminates."

The original survey of test methods made a few years ago was discussed and it was agreed that it should be reviewed and reported by the secretary. These data are available but must be studied and brought up to date.

The meeting adjourned at 3:45 p.m.

D. M. Gilmore, *Secretary*
G. L. Reidy, *Associate Secretary*

Corrugated Containers Division

Engineering Committee

Meeting was called to order at 9:10 a.m., May 10, 1960, at the Pittsburgh Airport Hotel, Pittsburgh, Pa., by Chairman Hutcheson.

The minutes of the New York meeting were approved as submitted. Motion by Goettsch, seconded by Nitchie.

Chairman Hutcheson appointed the following members to make informal presentations on a subject of their choice at the following committee meetings:

Toronto—Oct. 11, 1960: W. E. I. Davies, C. D. Nitchie
New York—Feb. 21, 1961: T. B. Haire, L. W. Kutz

The Engineering Committee Chairman should be advised of the specific subjects prior to each committee meeting in order that these titles may be included on the meeting agenda.

Discussion of 1960 Projects

a. The problem of inspecting the glue pattern on the folding flaps on corrugated boxes was discussed in some detail by various members of the committee. An attempt was made to define the problem and establish limits on what must be accomplished. Several ideas were suggested as possible sens-

ing devices. These included various "indicators" that might be added to the glue such as powdered iron or fluorescent materials that could be excited by high frequency energy sources. Also various optical means including photoelectric techniques were considered.

Mr. Nitchie indicated that a study was being made for his company in connection with this general problem. It was, therefore, decided to defer all action on this project until the Toronto meeting at which time Mr. Nitchie will present a progress report.

b. After considerable discussion of other projects that might be considered by the Engineering Committee, it was decided that the entire committee would consider the overall design of a typical box plant as a project for the next couple of years. Since the committee roster boasts experts in all phases of box plant design, it was felt that this would motivate everyone on the committee to become active. The following list of subjects was generated by the committee and rearranged in a logical order of importance. As indicated on the list various members were assigned to handle specific subjects.

*1.	Product Mix and Volume	F. E. Westfall
*2.	Plant Site, Location and Shipping Facilities	W. E. I. Davies
*3.	Machinery Selection and Drives	A. Richardson
	a. Corrugating	D. Nitchie
	b. Printing	L. W. Kutz
	c. Specialty	
	d. Finishing	
*4.	Materials Handling	T. B. Haire R. C. Hutcheson
5.	Area/operation and Machinery Layout	H. W. Moser
6.	Waste Handling System	J. E. Knecht
7.	Roll Storage and Handling	D. C. Ellinger
8.	Steam and Boiler House	W. E. I. Davies N. A. Anderson
9.	Starch System	A. Richardson
10.	Electrical Distribution Lighting Systems	R. C. Berger
11.	Heating and Air Conditioning	
12.	Plant Maintenance	
13.	Sample Room, Die Room, and Locker Rooms	
14.	Office Layout	
15.	Air, Water, and Miscellaneous Systems	
16.	Sewage Disposal	
17.	Structural Design	

* To be prepared for presentation at the Toronto meeting, Oct. 11, 1960.

In order that work could proceed in subsequent areas, Mr. Westfall agreed to distribute to all members of the committee his thoughts and ideas relative to product mix and volume well in advance of the Toronto meeting.

Future Committee Meetings

a. It was suggested by Mr. Richardson that consideration be given to holding the 1961 spring meeting in the area of a box plant location and that the meeting be extended in time to include a tour. Action was deferred until the Toronto meeting.

b. It was further suggested that consideration be given to extending the time of both the fall and New York committee meetings from one-half day to a full day. No action was taken at this time pending an investigation by the chairman with regard to possible conflicts with the Steering Council meeting.

Comparison of Static versus Rotating Power Conversion Units on Adjustable Voltage d.c. Drives

Mr. Berger reviewed the general characteristics of rotating and static power conversion units. A comparison chart was distributed to all members of the committee and this was reviewed in detail.

It was concluded that the basic difference between these two forms of a.c. to d.c. conversion is the ability to regenerate. Although the static converter does not have the ability to absorb pump-back power, this may be only of minor importance in the majority of industrial applications, where dynamic braking may do the job equally well.

During the past 18 months, based on a total of 47 power conversion units on printer slotters and corrugators, rotating M-G sets have accounted for the balance of 40%. On printer slotters alone the ratio is 65% rotating and 35% static. On corrugators the ratio is 55% static versus 45% rotating. These figures seem to indicate a growing acceptance of static power conversion units in the paper converting industry.

Progress Report Project No. 776

Both Mr. Newton and Mr. Westfall have instrumentation installed on corrugators for measuring take-up ratio. Mr. Newton's equipment has been installed since the middle of March on C-39 flutes. Both Mr. Westfall and Mr. Newton are experiencing difficulty in correlating their data. Variations are being experienced from medium to medium, from one line speed to another and from one width to another. Mr. Westfall indicated that his committee will continue to check takeup ratios until they can obtain reproducible results.

New Union-Bag Camp Plant at Spartanburg, S. C.

Mr. Hutcheson presented a chalk talk aided by photographs of the Spartanburg box plant.

It was interesting to note that the first step in planning for this facility included a computer study based on anticipated product mix and volume. After analyzing the results the corrugator trim size was selected, the presses were sized, and the finishing equipment was selected.

The next step in planning involved decisions with respect to the materials handling system. After considering the merits of many methods, in light the product mix, it was decided to fully conveyorize the new plant. A U-shaped production flow through the plant was then established with the corrugator at the base of the "U." All roll stock is delivered by rail and stored in an area adjacent to a spur that will accommodate five cars inside the plant. The flow from the corrugator through the presses and finishing equipment ends up in a shipping area adjacent to the truck docks. Transfer cars handle the product in process through three presses and finishing equipment which includes slitters, box makers, eccentric slotter, die cutters, tapers, and stitchers.

The building is of steel construction comprising 140,000 sq. ft. including 20,000 sq. ft. for offices. Nonload bearing walls are of red jumbo brick. The corrugating bay is separated from the rest of the plant by a corrugated metal dividing wall. Power supply is 480/277 v. with fluorescent lighting throughout the plant. Offices are air conditioned and constructed with movable sheet metal partitions with a honeycomb interior.

Discussion of Plans for 1961 Technical Session

The following speakers and tentative subjects have been committed for the New York meeting.

a. "An Evaluation of the Hooper Knife," by L. J. Grogan, Maxwell Bros. Inc.
b. "Take-up Ratio," by F. E. Westfall, Lanzit Corrugated Box Co.
c. "The Performance of 39-C Flute Rolls," by T. B. Haire, Continental Can Co.
d. "An Evaluation of the Langston Knife" (speaker to be announced within 30 days).
e. "Variable Heat on Double Facers" (an alternate subject if needed). R. T. Cassady was suggested as a possible speaker.

10. Meeting adjourned at 4:10 p.m. moved by Nitchie, seconded by Goettsch.

R. C. Berger, *Secretary*

Raw Materials Committee—Subcommittee on "Medium"

Henry Nelson was not present, but had advised the chairman that he had not been able to finish the report on the relation between moisture absorption tests and pin pull test results.

New projects were discussed and it was decided that a preliminary survey on moisture variations within the width of medium e.g., wet streaks which could be tolerated without causing operational and quality difficulties, should be made. John Hart would chairman this project assisted by Burt Jones. Based on experience with their own companies, they would send questionnaires to any member of the committee they thought might be able to help in the preliminary study. The preliminary report would be distributed to the committee by May 1, so that if additional data were required, time would be available to gather it and analyze it before the October meeting.

A suggested project for liners was to investigate the relationship of surface characteristics on heavy liner to edge bonding. It was agreed to poll the members of the committee as to the value of initiating a study of this subject.

C. H. Robson, *Chairman*

Engineering Division

Steam & Power Committee

An Interim Meeting of the Steam & Power Committee was held at the Lake Tower Motel in Chicago on March 28, 1960. A total of 18 attended the meeting including H. O. Teeple from TAPPI Headquarters. Less than 45% of those attending were mill people. Eighty per cent of the absentees were mill people. At this important work session, we need greater numbers of our mill people attending and actively participating in the affairs of our committee.

The 1960 committee membership totals 28—up two from 1959. A resignation was accepted from E. H. Donley, who has served our committee well for several years. New members of our committee are:

Charles C. Bush, Union Bag-Camp Paper Corp.
W. J. Darmstadt, Babcock & Wilcox Co.
F. W. Hochmuth, Combustion Engineering, Inc.

A complete Membership List for 1960 (W-60-3) was mailed to each of the committee on Jan. 11, 1960. A revised list (W-60-5) of subcommittee assignments was sent to members.

Report on TAPPI Staff Meeting

John Hoad reported on the TAPPI Staff Meeting held in New York on February 22 which he attended as representative of the Steam & Power Committee.

Committees were reminded that TAPPI rules require each committee to hold a minimum of one meeting per year. The Steam & Power Committee have had two meetings per year for several years.

Details of the Fifteenth Engineering Conference were discussed and items affecting Steam and Power will be included later under the heading "1960 Engineering Conference." Mr. Hoad has offered his assistance to the Local Arrangements Committee in securing a keynote speaker.

The handling of Engineering Conference papers was discussed at some length. In the past, availability of printed copies of the conference papers has been dependent upon the author's desire to print copies and bring them to the meeting for distribution. The Steam & Power Committee sponsored papers have usually been available for those attending the conference. The idea of having copies of all conference papers preprinted and bound was considered, but no final action was taken in February. Since that meeting, TAPPI has made the decision to preprint papers for the Fifteenth Engineering Conference and bind them in a single book for distribution to all conference registrants in Jacksonville.

Steam and Power Committee interim meeting, Chicago, Ill. Back row, l. to r.: R. V. Knapp, H. O. Teeple, H. B. Wallace, C. R. Podas, H. R. Emery, J. G. Hoad, F. W. Hochmuth, W. H. Hall, and W. J. Darmstadt. Seated l. to r.: W. B. Wilson, G. B. Gregg, C. L. Wills, F. H. Coldwell, L. Limon, G. L. Yeakel, G. M. Ellis, C. C. Bush, and J. E. Hoeft

Steering Committee

Mr. Emery announced formation of a Steering Committee which comprises the Steam & Power Committee officers, the past chairman and C. R. Podas.

This committee met in Jacksonville on February 26 and Mr. Emery's February 29 memorandum advised of the Steering Committee's functioning and included their recommendations for consideration by the overall Steam & Power Committee at the Chicago meeting.

The prime objective of the Steering Committee is to increase the overall effectiveness of the Steam & Power Committee. By scheduling interim meetings, the Steering Committee can consider various activities that are within the scope of Steam and Power, compile preliminary data, and then prepare an agenda with pertinent facts that will assist the overall Steam & Power Committee in adopting programs which will serve the industry most effectively.

Subcommittee Operation. One basic recommendation of the Steering Committee was that all subcommittees should schedule their work into manageable sections that can be completed and reported on within one year. This means that the longer projects must be broken into logical work-pieces requiring only one year to complete. It is expected that this philosophy of operation will result in:

1. An increased feeling of accomplishment on the part of those subcommittees whose overall projects require more than one year to complete.
2. Material will be made available for the use of TAPPI membership and the industry at an earlier date.
3. An increased ability to rotate subcommittee members at 1 to 3 yr. intervals with minimum effect on completion of long projects. A poll last fall indicates that all Steam & Power Committee members are interested in all our activities and will be interested in an opportunity to contribute to a number of different subcommittee activities.

Each subcommittee is to make two reports each year.

1. At our committee meeting during the Engineering Division Conference each fall, the report is to include: (a) Recommendations for continuance of the current project. (b) Recommendations for new projects. Projects will be reviewed by the Steering Committee and their recommendations presented to the Steam & Power Committee for discussion and approval at the next spring meeting.
2. At the annual spring meeting, a final report of the year's work assignment agreed on at the Steam & Power Committee's previous spring meeting. At this time, the committee will decide on final disposition of the material such as publication in TAPPI, data sheets, etc.

Objectives of subcommittees functioning prior to this time were listed in a report (W-59-13) of the Steam & Power Committee activities during the Fourteenth Engineering conference. Objectives of newly formed subcommittees will be included in a report after the Fifteenth Engineering Conference.

Annual Listing of Power Plant Equipment in Industry (Project No. 681). This project was dormant in 1959 primarily because other duties made it necessary for Earl Donley to resign from our committee.

The Steam & Power Committee has continually expressed an interest in this project and it will be continued with H. B. Wallace, Jr., as subcommittee chairman.

This subcommittee is to "watch dog" TAPPI Headquarters to be sure their questionnaires are suitable for collecting the data needed. Even though a majority of the work can be handled by TAPPI Headquarters, it is the subcommittee's responsibility to be sure that items reported and method of reporting always factors in possible changes to make data more useful.

The suggestion was again made that TAPPI schedule publication of this data for the same month each year. In this way, interested people will be looking forward to the next listing to keep them abreast of latest power plant practices.

Training Power Plant Engineers (Project No. 682). Charlie Wills reported in the absence of Tom Woodward. This project is to be concluded with a panel discussion arranged by Tom Woodward for the Engineering Conference in Jacksonville on Oct. 27, 1960. These panel discussions will be written up by the panel members so they will be available for TAPPI preprinting and for publication in *Tappi*.

In addition, Tom Woodward has been asked to prepare a bibliography with exhibits and other pertinent data summarizing his subcommittee's work on this subject. If this material can be reproduced and distributed to members of the Steam & Power Committee at the time of, or before, the Jacksonville conference, final recommendations of Mr. Woodward's Subcommittee can be reviewed at our Steam and Power Committee Meeting in Jacksonville.

Steam and Power Consumption (Project No. 683). John Hoad reported for his subcommittee and distributed copies of a "Steam and Power Consumption" questionnaire to all present John had previously polled his subcommittee for suggestions on a questionnaire and actual mill records to guide in the preparation of this proposed questionnaire. The questionnaire was distributed to the subcommittee members prior to this meeting. In an effort to cover the widely varying combinations of equipment and different processes, the questionnaire is rather voluminous.

Committee members recognize the broad scope of this project and are concerned lest the data be of such a general nature that it cannot be directly related to an individual mill's specific performance. General consensus in the committee was that the detailed information requested was probably essential for the committee to do a good job. Even so, the present questionnaire includes more data than can be obtained, analyzed, and presented in one year. It was suggested that consideration be given to a "short" questionnaire that would include a narrow segment of the industry and use this data as "building blocks" for the overall finished report.

On March 30, John Hoad wrote each member of the Steam & Power Committee so all would have two copies of the questionnaire. In a March 31, 1960, letter, Ross Emery also outlined the reasons help was needed and asked each member of the committee to reply to John Hoad by June 1, 1960.

With data and comments from the overall committee, Hoad will consider any changes necessary to accomplish the long range objectives of the committee. He will also come to the Jacksonville meeting with a recommendation as to what specific segment of the overall job should be started for completion within a year. Some suggested that a specific questionnaire related to "groundwood" would be a logical segment of the overall project to consider for completion first.

Engineering Data Sheets (Project No. 684). In the absence of P. L. Nelson, Charlie Wills reported that the Data Sheets Committee has first draft of a data sheet on "Power Piping Specifications" nearly complete. George Gregg has agreed to have the draft reviewed and returned to Mr. Nelson for final committee review and processing.

Mr. Nelson has since been advised of the committee's desire to have him select a project which can be completed before the 1961 spring meeting. It is expected that Mr. Nelson will make a status report at the Jacksonville meeting on the project being completed this year and make recommendation for next year's project.

Progress in Nuclear Power (Project No. 726). Henry Wallace reported for his subcommittee and had an excellent report on "Nuclear Industry Progress Summarized" for each of the committee members present. Copies of the bound report are here included for committee members who were not present at our Chicago Meeting. This report typifies the kind of project completion and reporting desired from each subcommittee at each spring meeting in the future.

Mr. Wallace has since edited his full report and forwarded it for publication in *Tappi* as requested by the committee.

In keeping with the philosophy of rotating subcommittee personnel, G. B. Gregg was appointed chairman of this subcommittee. The committee agreed that scope of the Progress in Nuclear Power Subcommittee should be limited to the use of nuclear energy in power applications.

Question and Answer. Joe Mailhos was not present to report for his subcommittee but questions and answers related to Steam and Power have been supplied and published in *Tappi*'s new section sponsored by the Engineering Division.

Chairmanship of this subcommittee has rotated to Milton Ellis.

Program. To better describe the work of Mr. Podas' "Papers Review Subcommittee," it was agreed that the name would be changed to "Program Subcommittee."

Mr. Podas reported that authors of papers for the 1960 Engineering Conference had reported good progress and that no difficulty in meeting deadlines was anticipated. Mr. Woodward is following speakers on the panel portion of the program and, at last report, expects no difficulty.

This subcommittee is responsible for correspondence with those participating in Steam & Power Committee sponsored technical sessions. They will follow through to see that time schedules are maintained, so papers are reviewed by competent individuals before presentation, and so that abstracts and manuscripts are available as required for programs, preprinting, etc.

Developments and Their Effects on Steam and Power Systems (New). This subject has been discussed in committee meetings for some time and a temporary subcommittee on this general subject was set up at the 1959 spring meeting. Because of the importance of new developments, this new subcommittee was established with C. C. Bush as Chairman.

Different projects, acceptable to the Steam & Power Committee were suggested for the subcommittee's consideration. Before leaving Chicago, Mr. Bush advised that "High Velocity Air Driers" had been selected for their first year's project.

Mr. Bush's subcommittee will have an interim report on their work at time of our Jacksonville Meeting and expects their final report on the first project will be available at the 1961 Spring Meeting.

Recovery Boiler Operations (New). Interest in this subject indicated need for this new subcommittee with J. E. Hoeft as chairman. Mr. Hoeft was given past correspondence on the subject accumulated by the Secretary.

This subcommittee will consider the overall subject from both the short range and long range viewpoint. In Jacksonville, Hoeft will report to the committee with recommendations on scope and procedures to be followed by his subcommittee.

Membership (New). The overall Steam & Power Committee membership has a reasonable split between paper industry and nonpaper industry people. Even so, more active mill representation is needed and this new subcommittee, with N. H. Mailhos as chairman, was established to keep our committee staffed with the competent personnel required.

Nick is already very active in contacting people with knowledge and experience that can add much to the overall effectiveness of the committee.

Publicity (Disbanded). Because TAPPI Headquarters are taking a more positive approach to publicity, it was decided to disband the Publicity Subcommittee. The secretary will pick up any remaining functions not taken care of by TAPPI's publicity group.

1960 Program. H. R. Emery will be chairman of the Steam & Power Session at the Fifteenth Engineering Conference in Jacksonville. The session is scheduled from 9:00 a.m. to 12:00 noon on Thursday, Oct. 27, 1960, in the Hotel Robert Meyer. The program is as follows:

1. "Why The Power Plant Personnel Should Supervise and Operate the Recovery Unit," by H. R. Arnold, Continental Can, Greenville, S. C.
2. "Water Treatment for Boilers Operating in the 600–1250 Lb. Range with High Make-up," by Leonard Limon, Graver Water Conditioning, N. Y., and R. A. Dando, St. Regis Paper Co., Deferiet, N. Y.

Panel

1. "Training of Power Plant Personnel." *Moderator:* T. F. Woodward, Scott Paper, Detroit, Mich.

Panel Members

Milton S. Ginter, Dow Chemical Co., Midland, Mich.
R. M. Van Duzer, Detroit Edison, Detroit, Mich.
J. W. Herrington, Buckeye Cellulose Corp., Foley, Fla.

It is hoped that a limited number of good, prepared discussions of the authors' papers will be available in addition to the very important extemporaneous discussions from the floor. To encourage questions from the floor, it is planned to distribute cards so the audience can write down questions without danger of forgetting. In addition, some are reluctant to get up and ask a question in public, and they too can have their questions answered by passing in their card.

1961 Program. Steam and Power subjects have been selected for TAPPI's Sixteenth Engineering Conference scheduled at the Shoreham Hotel in Washington, D. C., Oct. 15–19, 1961. With the wide variety of subjects and the great interest in all of them, a vote at the Chicago meeting established the final subjects selected for the papers and the panel discussion.

Papers

1. Centralized Control of Steam and Electric Power in the Pulp and Paper Mill.
2. Economics of Operating One 20,000-Kw. Turbo-Generator Versus Two 10,000-Kw. Units Taking into Consideration Reduction of Production During Unit Inspections.

Panel

Waste Heat Reclamation in Pulp and Paper Mills. (This will not include fuels or other combustibles.)

Authors and panel members have not been selected. Some suggestions have been received and, if each committee member will let me have their suggestions, it is hoped that the selection of participants for the 1961 Steam & Power Session can be finalized at the time of our Jacksonville Engineering Conference.

1962 Engineering Conference. TAPPI's Seventeenth Engineering Conference is scheduled as a joint meeting with CPPA at the Queen Elizabeth Hotel in Montreal, Que., Oct. 14–19, 1961.

1963 Engineering Conference. Scheduled for Chicago.

General Discussion

Complimentary Registration. In an effort to get uniform handling of this matter, the committee recommended that the Engineering Division adopt the following procedure:

"Provide complimentary registration for all invited speakers on the program who are not TAPPI members."

Engineering Division Staff officers have since considered various aspects of the problem. Their policy is in general agreement with our recommendation except they expect paid registration from speakers from the paper industry or from suppliers of the paper industry.

Subcommittee Meetings. The important work of the subcommittees takes time. Even though they may need to hold separate interim meetings, very little of this has been done. Several subcommittees did, however, meet in Chicago for a short while after the main Steam & Power Committee was adjourned.

General Committee Operation. At a previous meeting, the question was raised as to whether or not our committee might function more effectively if divided into two or more major interest groups. The poll of members indicated that all members have interest in all aspects of the scope included in Steam and Power activities. For this reason, active subcommittees with opportunity for rotation of subcommittee members should result in all committee members having opportunity for a very rewarding and varied experience in the broad field of "steam and power."

W. B. Wilson, *Secretary*

Systems Engineering and Operations Research Subcommittee Meeting

E. F. Thode, The Institute of Paper Chemistry, Appleton, Wis., Chairman of the Systems Engineering and Operations Research Subcommittee of the Chemical Engineering Committee, opened the meeting at 2:10 p.m., Feb. 23, 1960, at the TAPPI Headquarters Conference Room, 360 Lexington Ave., New York 17, N. Y.

Chairman Thode announced this was a joint meeting with AP&PA Ad Hoc Committee on Operations Research and extended a cordial welcome to those present.

Chairman Thode opened the discussion based upon a previously prepared agenda by telling of the plans by the TAPPI O. R. Subcommittee for the Fifteenth Engineering Conference to be held Oct. 24–27, 1960, at the Robert Meyer Hotel in Jacksonville, Fla. He stated the session to be sponsored by this Subcommittee would consist of four educational type papers, dealing with "operations research tools." The papers would be on (1) linear programming, (2) response surface techniques, (3) inventory and other probability models, and (4) stimulation. Authors have been procured for papers (2) and (4). An invitation was extended to those present to author, or arrange for authors, for the remaining two papers. (*Note:* Subsequent to the meeting an offer was received from one of the attendees.)

1. "Extent of Paper Industry Involvment in Operations Research—Discussion of TAPPI Questionnaire." Returns from the questionnaire circulated in January were summarized on February 15 in a memorandum to all who had originally been sent the questionnaire. Among the dozen companies reporting, operations research activity ranged from some rather minor problem solving to full fledged departments employing a half dozen or more professional workers. Some of the companies which did not have formally designated operations research departments were carrying on as extensive a program in this area as those that did. It was noted that very few of the individuals doing O. R. work in our industry

had had formal training in the sense of taking courses in collegiate institutions which had been specifically designated as operations research. On the other hand virtually all participants had had quite a significant amount of training in the mathematics and statistics required to gain a knowledge of the so-called "tools" of operations research.

2. "Working Definitions of O. R." There seems little difficulty over a working definition of O. R. as far as the paper industry is concerned. Two thirds of the replies to the questionnaire endorsed one of the two following definitions: (1) "Application of the tools of O. R. to any problems within the company." (2) "Mathematical and scientific analysis of company wide economic problems." These two definitions really are very much of similar import.

3. "The three major problems in any O. R. question, (1) the technical problems, (2) the semantics problem, (3) the effectiveness problem." It was pointed out that the large-scale systems most often studied in operations research invariably should be considered communications systems insofar as a major portion of the problem is concerned. There are three levels of difficulty in any communications system. First, there is the technical problem, which, while often extremely complex, is really the simplest of all. Next in difficulty is the semantic problem, that of being certain that meanings are properly conveyed. Finally, at the highest and most difficult level, is the effectiveness problem, where it is necessary to see that the transmitted meanings are translated into effective and desirable action.

During the discussion on these topics, it became apparent that some of those present did not realize that a serious semantic problem may exist among people with similar levels of intelligence and education. For example, the very simple term, "raw material cost," may mean one thing to an accountant in the controller's office and quite another thing to a plant technical service man. To move into the area of effectiveness, an example was given where an important department had an extremely serious inventory problem in the eyes of management. In the eyes of the operating personnel, however, they had no problem at all. The discussion served to bring out the very important point that the semantic problem is one with which all specialists connected with O. R. must deal. This includes the engineering and scientific individuals as well as the accounting, marketing, and general business specialists. It is furthermore apparent that the effectiveness problem is largely a problem of general management.

4. "The mathematical and scientific tools of O. R.—The Technical Problem." The discussion of this item revealed that objectivity is important. Tools would consist of anything which may be involved in the solution of the problem, i.e., mathematics, machines, the ingenuity and experience of the O. R. people.

5. "Need for close liaison among various specialists to deal with the semantic problem." This was agreed to be important to both TAPPI and APPA.

6. "Need for close liaison of specialists with management to deal with the effectiveness problem." The discussion of this item indicated it may be primarily an APPA function.

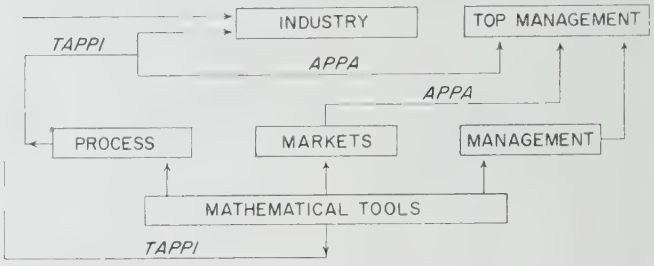
7. "Need for development of commonly required techniques without reference to possibly confidential applications." The discussion of this item indicated it was probably of major interest to TAPPI.

8. "Need for discussion of applications without reference to confidential data." It was suggested that APPA would be of significant help in securing management assistance when needed.

9. "In what way may TAPPI contribute to the needs of the (pulp and) paper industry in the O. R. Area?"

10. "In what way may TAPPI complement the activities of other groups, such as APPA, in this area?"

In a discussion of these two items, it was suggested the following chart may serve to delineate several viewpoints. Further, the discussion revealed, in O. R. application, committee activity is needed both in TAPPI and in APPA. Perhaps TAPPI emphasis would be on the technical problem whereas APPA emphasis would be on management relations. Common areas, which certainly exist, would involve strong liaison activity on the part of each association committee.



In summary, there appears to be a more serious need for liaison among the mathematical, engineering, and economic specialists rather than between technical and management.

In the ensuing months, efforts will be made to effect a strong liaison committee between the two associations and perhaps plan to present a jointly sponsored O. R. session next February during Paper Week.

H. O. Teeple, *Secretary, Pro Tem*

Process Instrumentation Committee

The meeting was called to order April 7, 1960, at the Pittsburgh Airport Hotel, Pittsburgh, Pa. by Chairman Powell, followed by self introduction of all present.

Data Sheets Subcommittee

A report was made by E. W. Prince in the absence of Subcommittee Chairman McCarty, who has resigned from our committee. It is planned that we will work with ISA and CPPA on instrument symbols. L. G. Good will distribute the ISA sheets. Mr. Good advised that an addenda will be soon put out by ISA.

Back row left to right: E. W. Prince, vice-chairman, Champion Paper & Fibre Co.; W. J. Frair, The Bristol Co.; G. L Harman, Bailey Meter Co.; R. T. Charters, Bechtel Corp.; D. P. Michel, Bauer Bros. Co.; J. L. Good, West Virginia Pulp & Paper Co.; H. O. Teeple, TAPPI. Front row left to right: R. D. Clarke, secretary, Minneapolis-Honeywell Regulator Co.; J. K. Powell, chairman, Bowaters Southern Paper Corp.; G. G. M. Eastwood, Kimberly-Clark Corp.; J. E. Overall, Fisher & Porter Co.; C. D. Lindwall, Rhinelander Paper Co.; H. E. Kirkland, Bowaters Engineering & Development, Inc.; D. J. Morrissey, Trimbey Machines, Inc.; L. G. Good, Panellit Service Corp.; R. G. Spangler, P. H. Glatfelter Co.

D. J. Morrissey volunteered to fill the vacant Subcommittee Chairman's post. He was so appointed by Chairman Powell. Others appointed on this subcommittee are: J. R. Lavigne and R. R. Gardner.

PROJECT 775

"The Principles of On-the-Machine Paper Moisture Measuring Systems." R. B. Hurm was not present to report. Chairman Powell pointed out that a paper will be presented in October on this project.

Several members suggested that limitations of the various moisture measuring devices be incorporated in the report.

SUGGESTED FUTURE PROJECT

A project was suggested on data handling and computation. Some joint action may be in order with the Operations Research Subcommittee.

The need for means of obtaining some primary measurements was discussed.

D. P. Michel volunteered to handle this project and was appointed chairman, with assistance from: J. L. Good and G. L. Harman.

Others, not on the committee, were suggested as useful help for this group.

COMMITTEE MEMBERSHIP

A report was given by E. W. Prince. Several new members were present at the meeting. Other men were suggested by members so that Vice-Chairman Prince could contact them. Copies of the current membership list were distributed.

QUESTION-AND-ANSWER COLUMN

Chairman Powell again asked that members forward suitable questions and answers to him for *Tappi*. Questions only are also desired.

PROJECT 692

"Organization and Importance of the Paper Mill Instrument Department." H. O. Teeple advised that the questionnaires had not been distributed yet. It was decided to add two questions to the list, then mail it. [A covering letter is to be prepared by Mr. Prince.]

The list is to go out as a survey and be directed to mill managers of individual plants.

TAPPI—ISA SYMPOSIUMS

Discussions were continued from previous meetings regarding ISA-TAPPI joint sponsorship of a symposium.

G. G. M. Eastwood advised that Fox River ISA was proceeding with plans for a Symposium for May, 1961. Louis Good also commented on the ISA approach regarding such a meeting including:

1. Minimum of three days
2. Pulp and paper oriented
3. No exhibits
4. Symposium quality papers—original work
5. Papers reviewed for insertion in ISA Transactions

Extensive discussion ensued regarding the means of participation by ISA and TAPPI and the role of each national organization and local section. Such a meeting is to be national in scope, but may be hosted by the local section of each organization.

A motion was made by Mr. Michel, seconded by C. D. Lindwall, and voted affirmative by the Committee that the TAPPI Process Instrumentation Committee become co-sponsors with ISA of the Fox River Symposium.

Mr. Lindwall was appointed as the committee representative (Co-Technical Chairman) to work with J. Replogle of ISA.

Further discussions followed this meeting regarding the details of the symposium and the mechanics of the ISA and TAPPI participation. Herb Teeple will play an important part in this. Another meeting of this group is scheduled in the next few weeks in Wisconsin.

The ISA First Annual Pulp and Paper Division Symposium will be held in Pensacola, Fla., April 27–29, 1960.

Mr. Morrissey advised that Empire State TAPPI Section is interested in working out a symposium for that area for 1962. He pointed out that this is also of interest to the Adirondack Section of ISA. Chairman Powell marked this as an agenda subject for our next meeting.

TAPPI—CPPA

Chairman Powell discussed the need for better communication with the Process Instrumentation Committee of CPPA. He has had correspondence with their chairman, J. T. Dykes. A copy of the minutes of our meeting are being forwarded to Mr. Dykes.

1960 ENGINEERING CONFERENCE—JACKSONVILLE

Chairman Powell announced the three papers available for this conference. It was decided to present these plus an interim report on Project 692. That survey should be mailed by the end of April and there should be a substantial number of returns by the end of June. The program is scheduled for Thursday, October 27 at 2:00 p.m. and consists of:

"The Principles of On-the-Machine Moisture Measuring Systems—TAPPI Project No. 775," by R. B. Hurm, Beloit Iron Works.
"Then and Now, Pulp and Paper Control and Measurements, 1906 to 1960," by E. J. Trimbey, Trimbey Machines, Inc.
"The Outlook of the Control Engineer," by D. P. Michel, The Bauer Bros. Co.
"Interim Report—Project No. 692—Organization and Importance of the Paper Mill Instrument Department," author to be announced.

1961 ENGINEERING CONFERENCE—WASHINGTON, D. C.

The TAPPI Timetable for papers was presented. It shows the need for early action on the papers. Suggested items for this conference include: 1. W. H. Marra of S. D. Warren Co., 2. Canadian Paper, and 3. Final report on Project no. 692.

Other subjects for this conference or the Fox River Symposium include: 1. Charmin yeast plant graphic; 2. Zimmerman process; and 3. Sweden's pulp and paper instrumentation.

SUBCOMMITTEES

Appointments were delayed until later.

ADJOURNMENT

The next scheduled committee meeting is to be on Thursday morning, October 27, during the 1960 Engineering Conference in Jacksonville. It was suggested that the Spring meeting next year be held in conjunction with the Symposium.

The meeting discussion session was adjourned, but was followed by the showing of the ISA film on, "Principles of Frequency Response."

R. D. CLARKE, *Secretary*

Industrial Engineering and Materials Handling Committee

The Industrial Engineering and Materials Handling Committee of the Engineering Division held a committee and data sheet meeting during Paper Week at the Hotel Lexington, New York City on Feb. 23, 1960.

Chairman Kendall called the meeting to order at 9:30 a.m. and the minutes of the Pittsburgh meeting were accepted as read by the secretary.

Burt Kendall then announced the desire of the Secretary, Hank Stoess, to be relieved of this position at the next Engineering Conference at Jacksonville. Hank stated that

Industrial Engineering & Materials Handling Committee, Feb. 23, 1960, Hotel Lexington, New York City

after eight years a change is due, but that he wished to remain on the committee. The committee accepted the retirement of Hank and elected unanimously Curtis Green as secretary of the committee and Fil Wilson as secretary of the data sheet sub-committee.

At the committee chairmen and secretary's meeting at TAPPI Headquarters on Monday, February 22, attended by Burt and Hank, breakfast meetings were discussed, but it was decided to have this meeting only for the speakers and committee offices. It was also announced that George E. Shaad will succeed Vince Owens as Division Secretary and that copies of all correspondence should go to George at General Electric Co., 1 River Road, Schenectady, N. Y., as well as to Vince until the changeover at Jacksonville.

Our program for Jacksonville in October of this year was finalized as follows:

"Storage and Handling of Clay," by H. A. Stoess, Jr., Fuller Co., Catasauqua, Pa.
"New Concepts for Automated Roll Handling," by Harold Sundahl and C. H. Eitel, Union Bag-Camp Paper Corp., Savannah, Ga.
"Sheet Finishing," by R. Carter, Crown Zellerbach Corp., West Linn, Ore.

The program for Washington, D. C., in October, 1961, was discussed. The topic for this meeting is "Wood and Chip Handling." Three papers have been decided upon. One, "Chip Storage and Handling," one author from the east, preferably from the APA and another author from the west coast to cover the subject completely, B. C. Kendall to procure authors. Two, "Wood Production and Harvesting," C. E. Payne to procure author, and three, "Wood Storage and Handling in Concentration Yards and Mills," Curtis Green to procure author.

Ray Sweitzer announced that the Mechanical Engineering Committee has included in their scope, wood handling. It was the consensus of this committee that this is a Materials Handling subject and should remain in this committee's province. The chairman was instructed to register a strong protest with TAPPI Headquarters.

With committee activities out of the way, the serious business of Data Sheets was then discussed, with time out for lunch and good fellowship. In the absence of Don Hall, our Data Sheet Subcommittee chairman, our Committee Chairman Burt Kendall assumed the moderator's chair. Data sheets and the action taken are as follows:

1. "Units of Measure Common to the Pulp and Paper Industry." Much discussion was had on Creed Reagan's suggestion on this sheet, but since this includes a glossary of paper mill terms it was thought that possibly this was something TAPPI Headquarters should publish and to author. It was decided to table this for a future meeting.

2. "Pulpwood Characteristics" (number of sticks per cord). As far as this committee is concerned this has been published as Data Sheet 196 and completed except for possible future revision.

3. "Pulp Storage Capacities." Completed as of May 18, 1959, submitted to Data Sheet Committee, but not published to date.

4. "Industrial Truck Specs." Completed as of May 18, 1959, submitted to Data Sheet Committee, but not published to date.

5. "Industrial Sizes of Noncaptive Pallets." Completed as of May 18, 1959, submitted to Data Sheet Committee, but not published to date.

6. "Salt Cake Storage Facilities." This data sheet was completed by Hank Stoess several years ago, submitted through the Data Sheet Committee during Fred Helverson's term as chairman and further submitted to the Data Sheet Editorial Board. In view of many controversial remarks, and since this same information was used in a paper by the same author, the author, H. A. Stoess, Jr., requested the data sheet be withdrawn.

7. "Flow Process Symbols." To be sent to TAPPI Headquarters.

8. "Flume Capacities." Preliminary copy to be sent by the secretary to Creed Reagan for proper arrangement.

9. "Wastepaper Storage Facilities." Secretary to ascertain progress made by Herb Teeple, re paragraph B, page 2 of minutes of the May meeting, also committee members to submit information on their own mills to Creed Reagan and to contact wastepaper dealers for further information.

10. "Pulpwood Characteristics." Fil Wilson reported the preparation of a questionnaire to determine the value of such a data sheet from interested personnel. The committee is to go over this questionnaire and to send their comments to Fil by March 15, 1960.

11. "Pulp Volumes versus Densities." It was recommended that this data sheet be referred to Herb Teeple and the Pulping Committee.

12. "Unit Weight per Cord of Chips." Hank Stoess reported much conflicting information received to date and unable to arrive at a definite conclusion. Committee thought this should be arrived at by the APA, therefore dropped. Secretary will, however, advise APA of decision.

13. "Characteristics of Materials Used in the Pulp and Paper Industry." Hank Stoess reported sheet in preparation and should be in final form on or before October, 1960.

14. "Application of Various Types of Material Handling Equipment." No report.

15. "Lineal Feet of Paper per Roll." Creed Reagan reported two minor changes to be made. Then, will be submitted to committee for vote.

16. "Roll Weights per Inch of Trim/Diameter." Jack Sweers reported further coordination between himself and Creed Reagen in progress.

17. "Pulpwood Storage Factors." Curtis Green reported conflict with item 10. Committee recommended that items 10 and 17 be combined.

18. "Winder Sets per Reel for Various Diameters." Further action required by Jack Sweers and Creed Raegan.

19. "Storage Aisle Width Requirements." Burt Kendall suggested that since this information is contained in the Reference Handbook of the National Truck Association, Washington, D. C., that this publication be added to the TAPPI Handbook Reference List, and further that the handbook be excerpted for a Data Sheet.

20. "Chart and Diagram Covering Normal Work Place." Information presented by Creed Reagan to be made into Data Sheet with minor corrections by Creed, assisted by Jack Sweers.

21. "Tractive Effort on Inclines and Ramps." Information submitted by Creed Reagan approved.

22. "Factors Affecting Plant Layout." Request progress report from Aux Schnyder.

23. "Standard Performance for Trucks." Jack Sweers suggested the use of CPPA data sheet No. N-9 issued December 1957, also, refer to Yale and Towne book on the subject and to check with the Industrial Truck Association, 900 F St., N. W., Washington, D. C.

The secretary, through the subcommittee chairman was authorized to inquire as to the status of completed data sheets and to report to the committee by mail as to results achieved.

A rising vote of thanks was given each member by other members for their interest and cooperation through their attendance and whole hearted support at today's meeting.

H. A. Stoess, Jr.

Electrical Engineering Committee

The meeting was opened at 8:30 a.m. April 20, 1960, at the Holiday Inn, Gainesville, Fla., by Chairman Andersen, the guests were introduced, then Mr. Andersen made a few complimentary remarks relative to the enthusiasm and cooperation of the various subcommittees which met the day previously, holding forth until 11:30 p.m. It is evident that these subcommittees are real working groups.

Following this brief discussion, the items on the agenda were taken in order as follows:

1. Mr. Stokely reported on the membership subcommittee as follows: Two new members are Messrs. Walsh and Collins. We are still making a drive for active new mill members and are awaiting replies to several invitations. The subcommittee chairmen were further advised that they could pick up membership for their committee where and when they saw fit, in order to handle their various projects, and that there was no limitation of the number of manufacturing representatives.

2. Mr. Thompson reported on the "Publicity and Question-and-Answer" subcommittee. Mr. Thompson indicated his dissatisfaction with the lag in publicity on the part of TAPPI. Even though he sends in publicity material, it does not get published. His complete report on this is attached as Appendix A.

Now that out subcommittees are strong working groups, Mr. Thompson would like to publish a roster of the subcommittees and copies of the minutes of their meeting.

Mr. Thompson mentioned that when we submit papers that they do not appear to be published in the technical section. Some of these papers are of considerable interest, and when published as special reports, only go to the committee membership and corporate members. Question was directed to Mr. Teeple, (TAPPI representative) as to how we should get the job done. Can we have these papers published elsewhere? Mr. Teeple indicated this was possible, however, the TAPPI would like to have the refusal of the publication. He is going to look into this problem and see what can be done to get out papers either published in TAPPI Technical Section or to get them published to the membership at large via the media of special reports.

Fifteenth Engineering Conference

3. The Electrical Session will be held at 9:15 a.m., Monday, October 24, in the Windsor North Room of the Hotel Robert Meyer, in Jacksonville, Fla. The only competition to this meeting is with the chemical engineering group, therefore, we should have a good attendance and authors should provide approximately 300 copies of their papers.

Our committee luncheon will be at 12:30, Tuesday, October 25, in the Dover Room. It is noted that Tuesday afternoon is also mill tour starting at 2:00, therefore, we would like to make this a short meeting. In order to do this, it will be necessary for the various subcommittees to meet prior to Tuesday noon, therefore, Mr. Wright was directed to arrange for a meeting room for the subcommittees so that they may meet Monday afternoon, evening, and Tuesday morning.

Papers for the Fifteenth Engineering Conference.

Mr. Sorenson's paper on "Ventilation of Motor Rooms" was withdrawn because of a similar paper that was to be presented at the AIEE session. In its place, four papers, by title only, were substituted. The following papers are being prepared for presentation at the Fifteenth Engineering Conference:

1. Project 620—"Power Requirements of Feltless Pulp Machines," a final report by title only to be presented by Mr. Collins.
2. Project 621—"Structural Board Machine Power Data," a final report by title only, to be presented by Mr. Fisher.
3. Project 852—"Selection of Refiner Motors," an introduction to the project by title only, to be presented by Messrs. Sakata, Porter, and Herrington. It is not intended that this project would be complete, but that the authors would prepare a summary of what they are trying to do and that certain data is required in order to get the data sheet, etc.
4. Project 857—"Overload Protection of A.C. Motors," a general discussion on the subject to be presented by Mr. Wright.
5. Project 790—"Electrical Problems in the Use of Purchased Power in Paper Mills"; Mr. Davey, Louisiana Power and Light.
6. Project 789—"End Thrust Problems and Considerations of Flexible Coupled Motors," a panel discussion, John R. Fielding of Union Bag-Camp Paper Corp. has accepted the job as moderator. Mr. Fenske will present the paper as an introduction to the discussion. The panel will consist of six members: J. F. Fenske, Allis-Chalmers Mfg. Co.; R. W. Foster, Champion Paper & Fiber Co.; J. V. Cundelan, Rayonier, Inc.; P. Hollingsworth, Koppers Co.; G. C. Werner, Thomas Flexible Coupling Co.; B. J. Oberembt, Flk Corp.

Mr. Wright read the time schedule guide for preparation and presentation of papers at the Fifteenth Engineering Conference. This is attached as Appendix B.

It was brought to the attention of the committee that if an author desires to furnish preprints of the paper, he must provide them. TAPPI has no facility for providing this service free of charge. In other words, the author must pay for preparing his paper for distribution at any TAPPI engineering conferences. Because of the principles involved, considerable committee discussion ensured. Mr. Teeple indicated that the chief difficulty was that TALPI Headquarters had no multilith equipment and was necessary to hire commercial printers for which there were no funds.

Mr. Harvey made a motion that this committee recommend to the chairman of the Engineering Division that TAPPI obtain the necessary offset letter press equipment in order to provide this service to authors when necessary.

Mr. Bobo seconded this motion. Motion carried unanimously. Mr. Anderson will take this up with Headquarters.

However for the Fifteenth Engineering Conference, the preprints will be the responsibility of the author and that it will be necessary to have about 300 copies. As a committee we want preprints, therefore, it becomes a responsibility of the membership to get the job done.

Author's Breakfast

We are going to instigate a new procedure in order to get all the authors together prior to the session. At this time, last minute instructions will be given on timing, arrangements, and so forth. This meeting will take form of an "author's breakfast," and the secretary is authorized to invite the authors by letter prior to the conference. Arrangements will be made by the secretary and chairman.

Mr. Sorenson will make arrangements for projectors, etc., therefore, the subcommittee chairman will send the author's requirements to Mr. Sorenson directly.

The secretary to mail a card on August 15 requesting the membership to indicate their attendance at the meeting and luncheon.

Data Sheet Subcommittee

4. Mr. Parrish reported on his activity on the Data Sheet Committee. The sum and substance of this was that data sheets are not getting published. Why? It was the committee's general opinion that there was no object in making up data sheets if they weren't published.

Mr. Cundelan reported on Project 783, Data Sheet Series 145, and indicated that each sheet must stand on its own. They are being rewritten and regrouped.

Then the discussion got back into why we didn't publish these sheets, one question was raised; why not publish them on a temporary basis, and then put on a permanent basis after the review board has gone over them. The main thing we want as a committee is to get action so that when a data sheet is made up, the TAPPI group as a whole get copies of these so that they may use them. As they stand now, only the Electrical Engineering Committee gets copies. Mr. Teeple indicated that he will have a complete report to Mr. Parrish by June 1 indicating the status of all our various data sheets. Then Mr. Parrish will resubmit where necessary, if some of these papers have been lost.

Subcommittee Reports on Activities

5. Mr. Anderson complimented the subcommittee chairmen on their activities at this conference.

1. Personnel—Mr. Perkins. No one present from this group. No report.
2. Construction Materials and Methods—J. R. Stephens substituting for Mr. Foster.
3. Motors, Generators, and Control Devices—R. J. Minges.
4. Generation and Distribution Systems—Mr. Bobe.
5. Drive Requirements, Pulp Mill—Mr. Herrington.
6. Drive Requirements, Paper Mill—Mr. Cundelan.
7. Drive Requirements, Finishing and Converting—Mr. Bobo.

The minutes of the various subcommittee meetings given in Appendix C.

6. The Sixteenth Engineering Conference will be held in Washington, D. C., in October, 1961. From the work of the subcommittees, it appears as if we can finalize the papers for this conference during the 15th Engineering Conference in Jacksonville. In this way, we will finally have obtained our goal of being a year ahead. And at Jacksonville, we will possibly arrange a tentative series of papers for the 17th Engineering Conference. Possible papers for the 16th Engineering Conference:

1. "Mill Experience with Sealed Insulation"—Mr. Porter.
2. "Advantages of Motor Control Centers"—Mr. Mower.
3. "Thrust Encountered on Motor Bearings When Using Telescopic Couplings on Jordans and Refiners"—Mr. Harvey.
4. "Calculations of Resistors for Wound Rotor Motors"—Mr. Wright.
5. "On Machine Coaters"—Mr. Collins.
6. "Functional Drive Requirements for Laminators and Corrugators"—Mr. Porter.
7. "Power Computations Values of General Mill Areas"—Mr. Mower.
8. "Equipment Grounding and Lighting Protection"—Mr. Cundelan.
9. "Power Centers to Include Economic and Engineering Factors"—Mr. Herrington.

1961 Interim Committee Meeting

7. It was generally agreed that our interim meeting would have to be before June, therefore, we could not meet with the AIEE group in Michigan. Mr. Andersen will advise on this matter.

There was no other new business, therefore, the meeting was adjourned at 12:10 p.m.

H. A. Wright, *Secretary*

APPENDIX A—PUBLICITY REPORT

Minutes of Publicity Subcommittee Meeting held on April 18, 1960, report to Mr. S. Andersen, chairman, Electrical Engineering Committee from H. W. Thompson, chairman Electrical Engineering Publicity Subcommittee.

The following material has been submitted to Mr. H. Teeple for publication in the TAPPI Magazine, and if my examination of each copy of the magazine is correct, none of these have yet been published.

Date Submitted	*Material Description*
Nov., 1959	Electrical Control of Fourdrinier Helper Drives, Project 748
Nov., 1959	Power Transfer Within Wet Felts, 747
Dec., 1959	Annual Report
Dec., 1959	General Purpose Semiconductor Rectifier Power Supplies, Project 772
Dec., 1959	Safety in Mill Electrical Work, Project 749
Dec., 1959	Supercalendar Power Requirements
Feb., 1960	Steering Committee Minutes of meeting held in New York

Our committee benefits regularly from the questions-and-answer column of the *Tappi*, the minutes of our October, 1959, committee meeting were published in December, the announcement of our new officers appeared in the March, 1960, issue as did the announcement of our interim meeting in Gainesville. The only paper published was "The Use of Butyl Rubber Insulated Cables" which appeared in the November, 1959, issue of *Tappi*.

Summarizing above, it is apparent short announcements and notices are accepted and published by TAPPI in a minimum of time, and is an excellent source of publicity. I might add papers submitted to *Tappi* need more time—some of above were submitted 5 months ago and still not published.

I suggest we concentrate on smaller, concise articles as the next approach to more widespread publicity.

Copies of minutes of all subcommittees should be forwarded in duplicate to the publicity chairman within 10 days to 2 weeks after each subcommittee meeting. These, in turn, will be submitted promptly to Mr. Teeple.

This subcommittee will appreciate ideas, comments, suggestions, and criticisms toward better publicity. Note, we need publicity within our own committee, within the Engineering Division of TAPPI, and consideration should be given to outside publicity.

H. W. Thompson

APPENDIX B—GUIDE FOR THE PREPARATION AND PRESENTATION OF PAPERS

Deadlines for the Fifteenth Engineering Conference at Jacksonville, Fla., Oct. 24–27, 1960.

Prior to previous conference—Committee program chairman to have subject of paper selected and will have solicited the paper from an appropriate author.

Previous conference—12 months lead time. Committee program chairman announces the titles and authors of all papers for his technical session.

March 28, 1960—7 months lead time. Committee program chairman receives rough draft of paper from author and forwards it to the committee paper review chairman.

May 30, 1960—5 months lead time. Committee program chairman submits recommendations, if any, to the author.

July 25, 1960—3 months lead time. Committee program chairman receives final paper, abstract, list of visual aids required, and biographical sketch.

Aug. 29, 1960—2 months lead time. Committee program chairman forwards paper, manuscript, and abstract to TAPPI. Requests for visual aids are also forwarded at this time.

15th Engineering Conference—Committee program chairman (or session moderator) presents author and distributes pre-

prints of the papers. *Re V. P. Owens' letter no. 38, Dec. 11, 1959.*

APPENDIX C—MINUTES OF THE VARIOUS SUB-COMMITTEE MEETINGS

Construction Materials and Methods Subcommittee

A discussion of subcommittee membership was held. Mr. Cundelan resigned due to committee work.

Current projects which were adapted with this status:

1. Up-date Data Sheet 157 to include data from Project 677. N. D. Kenney will be asked to do this.
2. A questionnaire on the "use and service record of interlocked armored tables" has been prepared. It is expected that a copy of this questionnaire will be sent to members of the E. E. committee for comment and approval. A deadline date will be set.
3. A report has been worked up on "The Resistance to Outdoor Weathering of Wire and Cable Joints and Insulation in a Pulp and Paper Manufacturing Plant." It is expected that this will be circulated to all E.E. committee for approval as a special report.

The list of future suggested projects was worked out as follows:

1. Table Rack System—Cost Comparison
2. Special Conduit System
3. Fire Alarm Systems
4. Cable Termination—Splicing
5. High Voltage D.C. Testing

Item nos. 4 and 5 were the outgrowth of questions submitted in a letter by M. J. Osborne.

John R. Stephens substituted for R. S. Foster as chairman of this group.

Subcommittee on Generation and Distribution

A meeting of the subcommittee on Generation and Distribution was held at Holiday Inn Motel, Gainesville, Fla., April 19, 1960.

Membership

L. J. Randall and G. E. Shaad have resigned from the subcommittee, and M. A. Buchta, of Gilbert Associates, Inc., of Reading, Pa., and L. F. Hayne, of Allis-Chalmers Mfg. Co., Milwaukee, Wis., have requested membership. I am writing each of these gentlemen accepting their offer to help with our work.

Current Projects

No. 507, "Pulp and Paper Mill Power Distribution," papers. Mr. Teeple and the chairman have scheduled a meeting in Atlanta, May 13, at which time we will prepare the material for printing. All papers and printing material are available and we need only to review for proper order and transition between the papers before printing the monograph, including all the papers.

Project No. 790 is a paper on "Electrical Problems in the Use of Purchased Power in Paper Mills." This is being prepared by Jack Davey, of Louisiana Power and Light. Mr. Davey will probably co-author this paper with some paper mill engineer. This paper will be presented at the Jacksonville, Fla., TAPPI meeting October 24 at 9:15 a.m. Mr. Wright has agreed to send Mr. Davey instructions on TAPPI paper preparation and presentation.

New Projects

Three new projects were started, which can ultimately result in papers for TAPPI Conference presentation. Some work will be done on all of these papers so that we may review our progress at the Jacksonville TAPPI Conference. The subjects as listed are in the order of priority on which we hope to have the work completed.

1. The general title of this subject is "Power Consumption Values for General Mills Areas." This study is to review the amounts of horsepower installed as well as the power required for operation of various portions of pulp and paper mills. L. D. Mower has already done some of this type of work, and will prepare an outline conveying his thoughts on what such a paper should include. This will be distributed among the members of the committee for review and suggestions on the final form the paper should take. It will undoubtedly be necessary for us to gather some data in making up the final paper, and this work will be distributed among the committee, or possibly by questionnaires to the mill. It is expected that by the time of the Jacksonville meeting we will be well enough along on this project to know what form the paper will take.
2. This subject is to cover "Equipment Grounding for Safety." J. V. Cundelan has worked on this subject before for the petroleum industry, and has the outlines of a possible paper for the paper industry. He will review his previous work and advise us how and if the data can be revised for making up a similar paper for the pulp and paper industry. Mr. Cundelan hopes to have something prepared on this by the Jacksonville meeting for further action by the Committee.
3. The suggested title for this paper "Economic and Electrical Considerations in the Use of Power Centers in Pulp and Paper Mills." C. G. Herrington has collected some information on this subject and will write this up in the form of an outline so that we may review it at our Jacksonville Meeting, with the idea of a paper being finally prepared from this data. This will also include a comparison of liquid versus air-cooled transformers which has previously been covered as a suggested subject.

Future Suggested Projects

1. Short Circuit Conditions on Low Voltage A.C. Systems.
2. Voltage Regulation Problems in Pulp and Paper Mills.
3. Use of Static Capacitors for Power Factor Correction and Voltage Regulation Problems in Paper Mills.
4. System Grounding and Grounding Resistors and Their Proper Identification and Location.
5. Industrial System Relaying.
6. Selection of Circuit Protection.
7. Selection of Generator Voltage.
8. Use of Reactors, versus Large Breakers.
9. Available Types of Distribution Systems for Large Paper Mills.
10. Relay Maintenance.
11. Switchgear Maintenance.

S. A. Bobe

Finishing and Converting Subcommittee

The Finishing and Converting Subcommittee held an interim meeting at the Holiday Inn, Gainesville, Fla., at 10 p.m., April 19, 1960, with P. C. Bobo, chairman. Subcommittee members in attendance were Messrs. Bobo, Collins, Farrell, Minges, and Porter. S. J. Campbell, Westinghouse Electric Corp., and A. C. Cook, General Electric Co., attended the meeting as guests.

The current project on winding was reviewed to better define the scope of the project. The decision was made to split the broad subject into two separate subjects: (1) Reel Drives for Converting Machine, and (2) Rewinder (Winder) Drives.

After making the above division, it was decided to limit the current project to a "comparison of types of reel drives for converting equipment" for the 1961 TAPPI Engineering Conference to be held in Washington, D. C. The author of this paper is to be R. J. Minges. The conference paper will be prepared in accordance with the following schedule:

First Draft—one week prior to 1960 Engineering Conference at Jacksonville. Subcommittee members' revisions returned to author Nov. 18, 1960.

Final draft—returned to subcommittee for approval Jan. 2, 1961.

Final paper to Electrical Engineering Committee for approval March 1, 1961.

Mr. Bobo will offer the above paper to the Electrical Engineering Committee for inclusion on the Engineering Division Program for 1961, and he will obtain a project number from the Electrical Engineering Committee. The following subjects were recommended as future projects for this subcommittee:

I. Drive Requirements of:
   1. Laminators
   2. Corrugators
   3. Printing presses
   4. Rewinders
   5. Bag Forming Machines
   6. Off-Machine Coaters
   7. Supercalenders

II. Register Control

III. Paper Inspection Equipment

The subcommittee decided to consider the subject of the functional drive requirements for laminators and corrugators as the next project. Mr. Porter will contact the Inta-Roto Co. for someone to co-author this paper with him.

The following men were suggested as possible new members for this subcommittee: Nyles Austin, of Marathon, Jim Pettigrew, of Potlatch Forests.

Meeting adjourned at 11:30 p.m.

C. C. Collin, *Secretary*

Pulp Mill Drive Requirements Subcommittee

Projects selected for this year are as follows:

Project No. 433—Selection of Chipper Drives. M. H. Fisher will review the data sheet 158 to determine if any revisions are desirable.

Project No. 659—Requirements for Steam and Power in Pulp Bleaching. It was decided to abandon this project since the generation and distribution subcommittee has undertaken a project to determine power consumption values for general mills areas.

Project No. 852—Drive Requirements for Refiner Applications. George Sakata of Black-Clawson has agreed to work on this project with Mr. Porter and myself and a representative of another manufacturer. It was decided that this project should not try to determine actual power requirements but should develop a data sheet defining torque and bearing thrust requirements and motor insulation and enclosure. It is hoped that this project can be completed soon enough to allow presentation by title at the 1960 engineering conference.

Drive Requirements for Washers, Deckers, and Vacuum Filters. C. C. Collins has undertaken this project to develop a special report covering these drives (project no. 851).

C. G. Herrington

Drive Requirements—Paper Mills Subcommittee

1. R. J. Farrell appointed as subcommittee secretary.
2. Data Sheets 145G and 145I.
   a. Series 145 will be discontinued.
   b. New series of numbers will be initiated with each sheet complete in itself.
      1. Introducing material.
      2. Data Sheet.
      3. Example of use of constants.
3. Data Sheet for fourdriner power requirements to include material from paper tower transmission of felts.
4. TAPPI Project 783—Data Sheet Revisions. Sy Campbell to review material from project 358—Power Requirements of foundriner machines and of cylinder machines. These sheets to be brought into line to incorporate items of 2 and 3 listed above.

The panel is comprised of six members:

Messrs. Fenske, Allis-Chalmers Mfg. Co.
Foster, Champion Paper & Fibre Co.
Cundelan, Rayonier, Inc.
Hollingsworth, Koppers Co.
Werner, Thomas Flexible Coupling Co.
Oberembt, Falk Corp.

Mr. Fenske's preliminary draft was mailed to subcommittee members on April 8, 1960.

Subcommittee members are to submit their comments on Mr. Fenske's April 8th draft to Fenske by April 21.

Fenske's final draft is to be resubmitted to the subcommittee by May 13.

Minges is to send Fenske's final draft to other panel members on May 20 with request that they return a draft of their prepared comments to him by July 1.

Minges will send draft of all panel members papers and/or comments to subcommittee members by July 5.

Subcommittee members are to comment on these drafts by July 15.

If any further comments and/or revisions are required, Minges will advise panel members by July 29.

Project "Overload Protection for A.C. Motors." A presentation by Mr. Wright will be made at Fifteenth Engineering Conference. Mr. Wright's previously submitted paper will be the basis of the presentation. Minges will circulate paper to members of Electrical Engineering Committee. Minges will ask committee to study with idea of having suggestions ready at Jacksonville, the subcommittee will act on committee suggestions for further work on this area.

Project 852—"Selection of Refiner Motors." This falls under jurisdiction of Drive Requirements—Pulp Mill Subcommitteee, C. Herrington.

Project—"Thrust Encountered on Motor Bearings When Using Telescopic Couplings on Jordan and Refiners." This project is an active project assigned to Mr. Harvey. He is to survey motor manufacturers and report at Fifteenth Engineering Conference Committee meeting. Plans are to have ready for Sixteenth Engineering Conference.

Project—"Mill Experience with Sealed Insulation Systems." This is active. Mr. Porter will contact motor manufacturers for definitions of individual scaled systems. Then he will survey Electrical Engineering Committee mill men for comments on their experience. He will report to Committee mill men for comments on their experience. He will report to Committee at Fifteenth Engineering Conference. Future action rests on this project.

Active projects for which subcommittee plans to be prepared by fall of 1961:

1. Project—"Mill Experience with Sealed Insulation," Mr. Porter.
2. Project—"Advantages of Motor Control Centers," Mr. Mower.
3. Project—"Thrust Encountered on Motor Bearings When Using Telescopic Coupling on Jordans and Refiners," Mr. Harvey.
4. Project—"Calculation of Resistors for Wound Rotor Motors," Mr. Wright.

From these four, two will be selected at Fifteenth Engineering Conference for presentation at Sixteenth Engineering Conference.

Meeting adjourned by Mr. Minges at 8:15 p.m.

J. F. Fenske, *Secretary*

Motors, Generators, and Control Devices Subcommittee

Meeting was called to order by Chairman Minges at 7:00 p.m. To bring subcommittee membership to better proportion of mill men to manufacturers, Mr. Minges will invite the following to join subcommittee:

Mr. Pettigrew, Potlatch Forests Inc.
Mr. Holmquist, Weyerhaeuser Co.
Mr. Horner, Bowaters Southern Paper Corp.
Mr. Sorenson, St. Regis Paper Co.

Active projects were discussed:

Project 789—"End Thrust Problems or Considerations of Flexible Coupled Motors." A panel discussion will be held at the Fifteenth Engineering Conference, Jacksonville, Fla., October, 1960. The main paper is to be presented by Mr. Fenske, Allis-Chalmers Mfg. Co.

5. Project No. 620—Power Requirements of Feltless Pulp Machines.
   a. Will be presented by title at 1960 Engineering Conference at Jacksonville.
   b. Recommended that a data sheet be prepared.
6. Project No. 621—Power Requirements of Structural Board Machines.
   a. Will be presented by title at 1960 Engineering Conference at Jacksonville.
7. Project No. 622—Power Requirements of Tissue Machines.
   a. Trouble in getting paper manufacturerrs to cooperate.
   b. Scott and Kimberly-Clark will be contacted again.
   c. Committee membership to date: Collins; Cundelan; Campbell; Pier; Farrell; Whitworth (to be contacted); Member from Rice Barton.
   d. If major mills will not cooperate, committee above will pool individual company information and will arrive at recommended constants.
8. Project No. 782—Project dropped. Combined with individual data sheets.
9. New Projects.
   a. Power requirements for aux. equipment for high velocity driers. Pier to investigate activity of another TAPPI committee working in this area. Future consideration will be given to this.
   b. On-Machine Coaters:
      1. Types of waters.
      2. Electrical and operational functions—start and stop, speed range, accuracy of control.
      3. Farrell to start project—accumulate present information, outline project, people to work on project have this ready by Jacksonville meeting. Collins and Campbell will assist on this study. Collins will also attempt to provide outline of paper.
   c. Monograph of paper machine drive papers.
      1. Power Requirements of Fourdrinier Machines—complete.
      2. Power Requirements of Cylinder Machines—complete.
      3. Power Requirements of Tissue Machines—being worked on.
      4. Power Requirements of Winders—complete.
      5. Power Requirements of Structural Board Machine—almost complete.
      6. Power Requirements of Feltless Pulp Machines—complete.
      7. Fourdrinier Machine Helpers—complete.
      8. Felt Tension Study—complete.
      9. On Machine Coaters—to be worked on.

Paper and Board Manufacturing Division

Fourdrinier Committee

The spring meeting of the Fourdrinier Committee of TAPPI was held at the Great Lakes Paper Co. in Fort William, Ont., on May 5 and 6, 1960.

The minutes of the previous meeting held in New York in February were read and approved as corrected.

Project No. 635—"The Problems of High-Speed Machine Operation." The answers to this questionnaire had been summarized in tabular form by Mr. Levensalior and were given to Messrs. Mullins and Brown to review. Mr. Mullins hoped to be able to present a summary discussion of the information at our fall meeting.

TAPPI Fourdrinier Committee Meeting May 5 and 6, 1960, Great Lakes Paper Co., Fort William, Ont., Canada. Left to right: H. H. Mullins, Olin Mathieson Chemical Corp., W. Monroe, La.; R. W. Hisey, S. D. Warren Co., Cumberland Mills, Me.; J. Hannigan, International Paper Co., Fort William, Ont.; G. A. O'Brien, Riegel Paper Corp., Acme, N. C.; W. H. Kennedy, Black Clawson Co., Watertown, N. Y.; R. N. King, Nash Engineering Co., S. Norwalk, Conn.; C. J. Jeffery, Great Lakes Paper Co., Fort William, Ont., R. W. Peters, Eastman Kodak Co., Rochester, N. Y.; M. A. Burnston, TAPPI, New York, N. Y.

Mr. Kennedy supplied copies of the tabulated results to all members present and will send more copies to all other members of the committee. It is hoped that each member will analyze these results and pass on any thoughts to Mullins and Brown.

Project No. 734—"Dandy Roll Practices." Mr. Hannigan presented a summary and discussion of the results obtained from this questionnaire by himself and Mr. Schad. This draft report and summary was approved by the committee for release as a special report. This should be very interesting reading for all of those mills running dandies. Mr. Hannigan and Mr. Schad were congratulated for meeting their schedule for completion of this project.

Projects Nos. 735 and 736 were cancelled as further investigation of these subjects had shown them to not be of sufficient interest.

Project No. 737—"Carrier Rope Practices." This project has been closed out by the presentation of a paper at the National TAPPI meeting by Mrs. Mullins.

Project No. 802—"Wet End Process Control." The draft questionnaire prepared by Mr. Hershey and Mr. Peters had been distributed to all present members of the committee before the meeting. A discussion was held and a few amendments proposed. The questionnaire was then approved by the committee as amended and it is hoped that the final form will be in Mr. Kennedy's hands by June 1 with a target data for a summary of returned results set for the fall meeting.

Project No. 792—"Suction Box Covers." It was reported that Mr. Morton expects that he and Mr. Fraser will be able to firm up the program for this project by the fall meeting. Mr. King reported further work on the vacuum drop from back to front of suction box on the machine. This work has lead him to conclude that the drop is in the order of magnitude of only fractions of an inch of water pressure. In this light this line of attack is probably of minor interest.

Preliminary discussions were held on the papers to be presented at the February National meeting. This program

will be finally determined at the fall meeting. The fall meeting of the committee will be held October 13 and 14 at the S. D. Warren Co. in Portland, Me.

The meeting was adjourned at 11 a.m., May 6, 1960.

Visits were arranged for committee members to the various mills in the area, including Great Lakes Paper, Mission, Thunder Bay, Provinical, and Red Rock. These visits were greatly enjoyed and the hospitality of the local mill men was deeply appreciated. The committee was fortunate enough to be able to attend a meeting of the Midwest branch of the Technical Section, Canadian Pulp and Paper Association.

ROBERT W. HISEY, *Secretary*

Pulp Manufacture Division

Deinking Committee

1. Discussion of the October, 1960, meeting indicated at the meeting held Feb. 22, 1960, in New York that Program Chairman Kinne had the program arrangements pretty well completed. Five of the eight necessary speakers had been definitely obtained.

Conference Chairman James Allen reported on the status of other arrangements.

2. Future conferences are planned as follows: 1960—Appleton, Wis.; 1961—York, Pa.; 1962—Kalamazoo, Mich.

3. There was preliminary discussion of these 1962 Conference items: a. Theme: "Deinking Around the World"; b. Speakers: From Foreign Countries. Dr. Nadleman was suggested to help obtaining speakers.

ORGANIZATION

It was the feeling of the group that certain changes were needed in the Deinking Committee and that the handling of the Program Committee needed to be definitely formalized. With this in mind a large portion of the meeting was spent in deciding on the items listed below (committee membership had been formalized at Holyoke in October, 1959).

1. Committee Purpose and Name. The duties of the Program Committee needed to be broadened and the name needed to be changed to "Steering Committee" in recognition of this change. (This was approved by the entire Deinking Committee at a later meeting on the same day.)

2. Committee Duties.
   a. Choose conference site.
   b. Recommend a conference chairman.
   c. Choose conference theme.
   d. Recommend a program chairman.
   e. Suggest specific subjects.
   f. Suggest possible speakers.
   g. Instruct and advise program chairman.
   h. Actively assist program chairman.
   i. Check and expedite program progress.

3. Committee Meetings. Twice yearly: (1) In February before the Deinking Committee meeting, (2). In October before the conference opens.

4. Duration of Chairmanship. The chairman should be appointed during the fall conference and should take office immediately to serve through the next fall Conference.

5. Schedule of Activity.
   a. In Feb. do the following:
      1. *Current program.* (First year) Check status through reports from the general chairman and the program chairman.
      2. *Next program.* (Second year) Discuss with the general chairman to find out what help is needed. Suggest specific subjects and speakers to the program chairman.
      3. *Third year program.* Tentatively select site and theme.
   b. In October do the following:
      1. Select and announce site two years in advance.
      2. Announce program chairman two years in advance.
      3. Announce conference chairman two years in advance.

6. Future Needs.
   a. Formulate and write articles of organization.
   b. Write up specific duties of each officer in the Deinking Committee.

NEXT MEETING

The committee will meet on Wednesday, Oct. 5, 1960, at the Conway Hotel in Appleton, Wis. at 3 p.m. This is immediately prior to the start of the conference on October 6.

If train or plane schedules or other reasons make this time illogical please inform the committee chairman so that other provisions can be made.

J. L. CLOUSE

Pulp Purification Committee

The meeting of the Pulp Purification Committee was opened by Chairman Kraft at 10:00 a.m., Feb. 22, 1960, at the Hotel Commodore. The minutes of the Feb. 23, 1959, meeting were read by the acting secretary and approved by the members. Items from the previous meeting, together with some new developments, were brought before the meeting by Dr. Kraft.

TIME SCHEDULE

The possibility of arranging a time schedule for presentation of papers had been left with him for discussion with the Manufacturing Division. This was done in the meeting of February 27 but no decision was reached. Mr. Teeple felt there was no reason why one committee could not start this procedure. He will check this with other divisions.

TWO SESSIONS

The Pulp Purification sessions scheduled this year represent accomplishment of the improvement sought after last year's single crowded session.

CHANGES IN OFFICERS

Dr. Kraft announced that Ferri Casciani (vice-chairman) and Don MacLaurin (secretary) had resigned their posts on the committee due to the pressure of their regular work. Mr. Casciani also resigned from the committee and suggested appointment of William D. Rice, research director at P. H. Glatfelter, as his successor. This met with committee approval. Mr. MacLaurin will continue on the committee. A motion was made and carried that both Mr. MacLaurin and Mr. Casciani be thanked for their efforts in behalf of the committee. The motion was approved.

1960 ANNUAL MEETING SESSIONS

The program for the sessions on February 24 and 25 were discussed. Dr. Rapson suggested it would be worth while to have the beginning of these sessions announced over the public address system. Mr. Teeple said there was no P.A. available but that we could have a page for this purpose.

TAPPI RESEARCH GRANT NO. 154

Dr. Rapson reported that Dr. Spinner had not completed the work yet. However, it will be finished by April 18. The summary has been prepared. Although the older literature is not pertinent or may be difficult to interpret, a complete study will be made. The report may require 40 to 50 typewritten pages.

Mr. Teeple suggested that TAPPI could probably publish the report with reprints available at the time of the conference in June. Some felt it could also be printed as a mono-

graph. There was some discussion on details of the findings. The summary of the discussion on Research Grant No. 154, made by Dr. Kraft, stated that the study will be completed in April within the frame of available funds.

TAPPI Monograph

Progress in the preparation of the Pulp Bleaching Monograph was reported by Dr. Rapson. The committee appointed to advise the editor has met and authors have been selected to write the chapters. Four authors have already submitted their first drafts. The drafts will be carefully edited with emphasis on cross-referencing between chapters. All drafts, received on time, will be returned to the authors before the June conference so that revisions can be made during the summer. The deadline for the rewritten drafts is to be Aug. 31, 1960. Publication of the monograph can be assured for the February, 1961, TAPPI meeting if all final drafts are available by November 1. It was noted that no authors of the previous monographs were asked to prepare chapters this time, with the exception of Raymond S. Hatch.

Foster Doane suggested that it is intended to use freely the material of the previous monograph and in order to give due credit to these authors, a summarizing reference thereto should be made, so that it would not be necessary to do this every chapter.

Pulp Bleaching Conference

Mr. Teeple presented a report dealing with arrangements for the conference, including hotel, publicity, publication of papers, printing, budget, etc. He will be in Chicago soon to make final arrangements. It was planned to print all of the papers in the June issue of *Tappi*. To do this, the papers must be submitted by April 1. Messrs. Teeple and Auchter will get together to decide on the deadline data and final publication plans.

Mr. Auchter presented a report on the technical program. People in other countries have been invited to present papers to maintain an international flavor for the conference.

The committee discussed the questions of authors paying their own registration. Mr. Teeple pointed out this was a committee decision. If the committee decides to offer free registration to any author, Dr. Kraft should write to these individuals that their registration has been paid and he should enclose a registration card.

Mr. Teeple asked if an evening session would be desirable in view of the possible crowding of the presently scheduled sessions. Decision was withheld for a closer program review. He also asked if there were any new budget items. Dr. Kraft said no financial assistance for overseas authors was included in the budget. Messrs. Teeple and Kraft will work this out.

Corrosion Committee

The Corrosion Committee has asked for a representative of our committee to meet with them. The function would be to convey our viewpoints to this committee. Our committee agreed this was desirable and Dr. Kraft will appoint a liason man.

West Coast Representation

Action along this line is to be delayed until the Chicago meeting.

New Activities

There are no new activities.

Nominations

Individuals selected by the Nominating Committee have found it impossible to accept the nomination. Messrs. Rapson and Doane suggested that Dr. Kraft continue as chairman in view of the important activities underway with Dick Auchter as vice-chairman and Louis Taylor as secretary. This arrangement was approved by the committee.

Research and Development Division

Microbiological Committee

R. E. Drescher, new chairman of the committee, and W. M. Van Horn, retiring committee chairman, presided at the meeting of the committee Feb. 22, 1960.

Election of Officers

R. F. Drescher was elected committee chairman. B. F. Shema was elected vice-chairman. M. Legator was elected committee secretary.

Discussion on Method T 487 m -54, "Fungus Resistance of Paper and Paperboard"

Comments of S. Steinberg of the Army Chemical Center, relating to this method was reviewed. The merits of including the soil burial test in this method was discussed. W. M. Van Horn moved that a soil-burial or soil block test be written as a separate method and that the chairman appoint a committee to draw up said method. Motion seconded by A. Stern and passed. The following committee was appointed: R. S. Williams, Chairman; B. F. Shema; and A. M. Stern.

The committee was instructed to work out a soil-burial test in conjunction with ASTM if possible.

Suggested Method for Manometric Determination of B.O.D.

E. O. Dillingham's Manometric B.O.D. Method was reviewed by the committee. W. N. Van Horn moved that a letter to A. J. Winchester be drafted proposing that suitable action be taken for consideration of the above method for TAPPI. Motion seconded by A. M. Stern and passed.

Research Program

The status of the research proposal of 1959 on the "Biological Modification of Lignin" was reviewed. W. M. Van Horn reported that Dr. Lewis of the TAPPI Research Committee objected to the long range nature of the proposal. It was suggested that the Fundamental Project Committee of TAPPI be informed that a literature survey on this topic has been completed and that a certain amount of screening has been carried out. It was moved, seconded, and passed that A. M. Stern prepare an additional proposal on this subject emphasizing the enzymatic phase of the problem.

The committee and present officers expressed their sincere appreciation to the retiring officers: chairman, W. M. Van Horn; G. Hunt, vice-chairman; and R. F. Drescher for a job well done.

The motion for adjournment was entertained, seconded, and passed at 4:45 p.m.

Marvin Legator, *Secretary*

Wood Chemistry Committee

The Wood Chemistry Committee and Fundamental Research Committee met in joint session Feb. 22, 1960 in New York, N. Y., to coordinate plans for sponsored research and sponsored symposia in the immediate future.

The following tentative plans were agreed upon for symposia:

Symposia During 1960–61

It was felt that the Wood Chemistry Committee plans for a TAPPI Lignin Symposium should be modified because of the Canadian plans to hold a lignin symposium at the large

IUPAC Meeting in August of 1961. It was therefore suggested that the Wood Chemistry Committee cooperate with the Canadian group and offer to share in sponsorship of this symposium.

Symposia During 1962

Jim Shipman suggested that the Fundamental Research Committee sponsor a symposium on "Nip Phenomena" in the fall of 1962 and this was tentatively accepted. It was felt that pertinent information on such areas as pressure distribution through the nip, felt action in a nip, flow of plastic material through a nip, and film splitting in the nip, would be available and of interest.

Dr. Moyer suggested a 1962 Symposium on "Non-woven Fibers in the Paper Industry," and Dr. Hearon suggested "Research Management Problems."

Project Funds

There was some discussion relative to the use of TAPPI funds for committee projects. It was clearly brought out that the Executive Committee is anxious to stimulate committee activity and feels efforts should be made to suggest and promote additional sound projects. In the past year only nine requests for research sponsorship were turned in by all committees and no requests were turned down. This is the lowest number in recent years.

Wood Chemistry Committee Sponsored Research

1. TAPPI Research Grant No. 165-Conrad Schuerch, *Isolation of Dimers from Lignin.* The final report on this grant was accepted and will be transmitted to TAPPI for publication. This project was terminated as Dr. Schuerch is now on a fellowship in England. A request that the $600 unexpended on this project be transferred to another project in Syracuse was turned down as our bylaws do not permit this. This money will therefore be returned to TAPPI.

2. TAPPI Research Grant No. 153-Kyosti Sarkanen, *The Mechanism of Bleaching of Lignin in Aqueous Chlorine Dioxide and Chlorite Systems.* Dr. Sarkanen reviewed his interesting recent studies on chlorine dioxide bleaching of model compounds, lignin, and wood meal. This work is essentially available to the committee members in the January 1960 report of Dr. Sarkanen. At the meeting, however, he indicated that he now feels that the true structure of the peroxide formed by chlorine dioxide is very likely the 1,4-peroxide. He is engaged in structure proof on this at the moment using the peroxide formed from the methyl ether of vanillin. It was suggested that he also check this with the ether of syringaldehyde.

In some preliminary studies on the treatment of wood meal with chlorine dioxide he stated that 70% of the phenyl propane units had been converted to peroxides. The committee expressed keen interest in his results and voted to continue this project with the addition of a second graduate fellow as requested in his proposal.

3. TAPPI Project No. 164-M. L. Wolfrom, *The Preparation and Chemical Properties of the Polymer-homologous Oligosaccharides of the Cellulose Series.* Dr. Wolfrom presented his evaluation studies on cellobiose oxidation with sodium hypochlorite. This mainly involved analysis of the amounts of various acids formed and this study will be continued with emphasis on the rates of formation of the various acids. Dr. Hearon expressed special interest in similar studies on the methyl glucoside. Dr. Tomlinson was interested in extending this study to cellulose, but Dr. Wolfrom will not be able to include this now. Continued support for this project was recommended.

Fundamental Research Committee Sponsored Projects

A request by Dr. Victor Gilpin of Trinity College for sponsorship of microscopic studies on the changes in the crystalline state of wood derived materials was considered. It was decided that this project should be accepted and placed under the Fundamental Research Committee. It was suggested that the microscopic fusion characteristics of wood lignin, as well as the cellulose, would be of interest. Apparently he has conducted some studies already on some of Dr. I. A. Pearl's compounds.

Frank J. Ball, *Secretary*

Testing Division

Adhesives Testing Committee

February 22nd Meeting

Minutes of the Dec. 9, 1959 meeting, as published by the secretary, were accepted.

The chairman requested the secretary to obtain a copy of proceedings of a recent symposium on high speed testing held at Boston under the auspices of the Plas-Tech Equipment Corp. of Natick, Mass.

It was the opinion of the committee that a reply to Dr. Clark on RC methods was not necessary since both methods were now published.

In view of the great increase of work load on most members, caused by the food additive toxicity legislation, it was agreed to extend the target date for completion of the monograph into 1961. Revised dates now call for an outline for the May meeting, first draft for September meeting, and final draft for December.

Fisher raised some questions about the scope of his assignment on latex adhesives. It was agreed that he will deal with elastomers and the Resin Emulsion group will handle the plastomers.

Carey reported that the pregummed work was awaiting action by Gummed Industries Association.

Keith Williams, vice-chairman of the Testing Division, spoke briefly on the projects assigned the committee and asked for early completion. Two projects, previously assigned other committees, have been given us: Project 397, Method for Testing Casein, and 437, Testing Glue.

February 23rd Meeting

Three papers were presented at the Adhesives Testing Session, open to all attending the Annual TAPPI meeting. A full house of over 200 heard the following papers presented:

Adhesives Testing Committee. R. D. Faunce, Reynolds Metals Co.; H. G. Psyras, Union Paste Co.; R. C. Brown, U. S. Envelope Co.; Elizabeth Weizenhoffer, Polymer Industries; W. H. Neuss, Armour Alliance Industries; J. P. Carey, Denninson Mfg. Co.; F. Fisher, Stein Hall & Co.; M. Breslouf, Borden Co.; and A. Hirsch, General Gummed Products.

"A Measure of Surface Tension and Surface Film Elongation," by P. B. Davidson, Mellon Institute, Pittsburgh, Pa.
"The Correlation of Laboratory Tack Testing with the Machine Performance of Adhesives," by F. M. Rosenblum and W. H. Neuss, Armour Alliance Industries, Alliance, Ohio.
"The Theory of Adhesion," by J. J. Bikerman, Massachusetts Institute of Technology, Cambridge, Mass.

The three papers were well received and a prolonged question period followed the presentations.

Following the papers, a brief meeting of the committee was held to receive the report of the Nominating Committee (Carey and Nichol). The Nominating Committee submitted the following list of nominees:

For chairman—Richard Brown
For vice-chairman—H. G. Psyras
For secretary—Elizabeth Weizenhoffer

There being no other nominations from the members, the chairman accepted the report. On motion made and duly seconded, the nominees proposed were elected. The new slate will take office for the September, 1960 meeting in accord with Testing Division policy.

The chairman adjourned the meeting at 11:45 a.m. with the reminder that the next meeting would be held May 18, 1960 at TAPPI Headquarters, 360 Lexington Avenue, New York, N. Y.

J. P. Carey, Jr., *Secretary*

Routine Control Methods Committee

The meeting was called to order at 12:15 p.m. in Parlor C by Chairman J. R. Gunning.

Chairman Gunning opened the meeting by announcing that seven RC Methods had been published in loose leaf form in December, 1959. They were RC 267 to 272 inclusive and a republication of RC 256. These seven methods have already been distributed to TAPPI members. Two more RC Methods were published in the January issue of *Tappi*.

The matter of providing binders for the RC Methods was brought up. Jack Winchester stated that at the present time ring binders were not being furnished free to members.

Larry Slentz moved that a binder be made available by TAPPI for sale to those members who requested them. Lyman Aldrich seconded the motion and it was so voted with the recommendation that the binder be of the 3-ring type rather than the 7-ring type as used on TAPPI Standards.

The question of adoption of the new category type index was brought up. It was suggested that the category index be broadened to include all possible sources of methods.

Dick Hunter moved that the matter be referred to the Testing Steering Committee for investigation. Joe Carey seconded the motion and it was so voted.

Larry Slentz then gave a report to the committee on the "Carton and Container End Use Symposium" held in Cleveland by the Lake Erie Section. The symposium was sponsored by the Packaging Institute. Two members of the RC Methods Committee attended. He stressed the value of such meetings as a source of obtaining new RC Methods and the importance of having representatives of the committee in attendance at these meetings.

Jack Gunning reported on the TAPPI Maine-New Hampshire Section meeting.

The meeting was adjourned at 2:00 p.m.

A second meeting convened on February 23 at 9:15 a.m. in the East Ballroom Parlor.

The meeting was opened by Chairman Gunning with a general review of the status of the 37 RC Methods currently in process. Where necessary, re-assignments of the methods for review were made to the various committee members.

Reference No.	*Method*	*Status*
60–1	Testing of alkaline products discoloration on printed packaging materials	In process for publication as RC 275
60–2	Forming handsheets for physical tests of pulp for corrugating medium	In process for publication as RC 276
60–3	Repulpability of splices	Sent to author 1/26/60 by Slentz
60–4	Test for reversion of bleached pulp	Sent to author 1/27/60 by Slentz
60–5	Dirt in pulp measured by transmitted light	Ready for publication
60–6	Use of the Ohio Boxboard score bend tester	Returned to author 1/27/60 by Slentz
60–7	Sodium in kraft lime sludge (Flame photometer method)	Original to Slentz 1/60
60–8	Analysis of salt cake (Colorimetric determination of magnesium)	Original to Slentz 1/60
60–9	Analysis of weak black liquor for active alkali	Original to Slentz 1/60
60–10	Sodium salt content of kraft pulp (Flame photometer method)	Original to Slentz 1/60
60–11	Internal bond test (Scott bond tester)	To be re-submitted by Benz with 60-28
60–12	Determination of per cent elongation of creped paper	Recommended by J. Winchester that pages 211–218 be revised and the method be published as part of RC 215
60–13	Efficiency test for DC Antifoam	Aldrich rewriting to general terms for all defoamers
60–14	Analysis of neutral Sulfite semichemical liquors	To Gordon Rabeler for editing
60–15	Softness of paper (Gurley)	To M. P. Boland for editing
60–16	Porosity of paper (Sheffield)	T. Lashoff now editing
60–17	Tensile strength of paper (Electro hydraulic tester)	Cancelled
60–18	Degree of sizing in paper (Carrier)	P. S. Cade now editing
60–19	Relative humidity (Bendix Pyschron)	Cancelled
60–20	Smoothness of paper (Sheffield)	T. Lashoff now editing
60–21	Formation in paper (Thwing-Albert)	Dick Hunter now editing
60–22	Softness-stiffness in paper (Clark)	Cancelled
60–23	Pin adhesion strength of corrugated board	Recommended RC 269 be revised to include this method
60–24	Porosity, air permeability or air resistance of paper and paper products (Gurley)	Cancelled
60–25	Stiffness in paper and board (Gurley)	To Gunning for editing
60–26	Torsion tearing resistance of paper (IPC torsion tear tester)	Ed Benz to review
60–27	Mullen burst test and hardness index of pulp	Haynes to check revisions with author
60–28	Coating pick test using internal bond tester	To be resubmitted by Ed Benz with 60-11
60–29	Quality of silicone release coatings	Aldrich and Renke rewriting
60–30	pH value of clay	Bill Willets to review
60–31	Grit and/or screen residue of clay	Bill Willets to review
60–32	Viscosity of coating clay slurry	Bill Willets to review
60–33	Sedimentation tests of coating clays	Bill Willets to review
60–34	Brightness of clay	Dick Hunter editing
60–35	CPS tests for coating clays	Bill Willets to review
60–36	Rapid identification of wet strength resins	E. N. Poor rewriting
60–37	Use of the Vanceometer	Ready for publication

Routine Control Methods Committee

As of Feb. 23, 1960, the status of the RC Methods in process are below:

Sources of new methods were then discussed.

M. A. Burnston agreed to submit an RC Method on "Brightness Method Using the Photovolt Meter." He also agreed to furnish Jack Gunning with a list of methods involving various stiffness tests using Gurley, Tabor, etc., instruments.

Leon Tyler agreed to check some government test standards as a possible source of RC Methods.

The meeting adjourned at 11:00 a.m.

B. Q. Haynes, *Secretary*

Optical Methods Committee

The Optical Methods Committee met at the Commodore Hotel, New York, N. Y., Feb. 22, 1960.

The minutes of the meetings in Portland, Ore., on Aug. 18 and 20, 1959 were approved.

The name of our group is now the Optical Methods Committee.

Non-TAPPI Optical Methods Projects

1. I.S.C.C.
   Announcement was made of the Inter-Society Color Council Meetings to be held in Philadelphia, April 11, 12, 1960. The I.S.C.C. has several projects under study of interest to us; one in the area of color matching and another in the area of fluorescence.
   Mr. Vincent will report on I.S.C.C. items of interest for TAPPI.
2. ASTM D-6
   No report.

Reports of Related TAPPI Groups

1. Routine Controls Committee. All members are asked to submit to the Routine Controls Committee such routine control methods as can be written up for TAPPI membership use.

Review of Committee Projects

No. 144. Illuminants for Color Matching. ASTM I.S.C.C., and MacBeth are active in this field.

No. 321. 75° Gloss (Wink). Mr. Vincent reported that the new glossmeter specifications have been received. These specifications are aimed at a tolerance of ±1% of full scale between instruments which is much more difficult to obtain than ±1% on a single instrument. The revised method will soon go to the committee on the whole.

No. 564. Brightness (Van den Akker). This project concerned the revision of T 452 to include paperboard. The assigned work has been completed and Project 564 is to be discontinued.

No. 795. Brightness (Van den Akker). T 217 and T 452 both require revision because of changes made on the illuminant and receiving systems of the GE meter.

The committee by consensus agreed that the method for making handsheets for brightness tests (T 218) should be improved.

No. 565. Opacity (Van den Akker). The work on this project has been completed.

No. 566. Chapman Smoothness (Obenshain). No report.

Proposed New Projects

1. The Spectrophotometric Evaluation of Optical Brighteners. Mr. Patek and Mr. Grum of Eastman Kodak gave a detailed account of the problem and what is being done.

About 15 participants are active in a round robbin to evaluate the usefulness of the Beckman DK-2 and the Beckman DU spectrophotometer in the detailed analysis of fluorescent additives. The method of employing the DK-2 will appear in *Tappi* very soon.

2. Transparency and Show Through. The committee agreed that projects or cooperation with other committees should be undertaken in the areas of transparency and show through.

3. The Examination of Paperboard Surfaces by Tangent Lighting. The committee makeup for this study will be announced as soon as possible.

4. Vanceometer Ink Permeability. No decision was reached as to action that should be undertaken.

Old Business

None.

New Business

Hunter Associates has built a distinctness-of-image glossmeter based on the principle set forth by Middleton and Mungall. The characteristic measured is the degree to which a test surface reflects a mirror image where the sample tested is visually capable of reflecting a mirror image. This characteristic can also be evaluated by the kurtosis techniques described by Nimeroff.

The next meeting of the committee will be at the eleventh Testing Conference in Grand Rapids in September.

A. G. Lang, *Secretary*

Eleventh

Testing Conference

of the

Technical Association

of the

Pulp and Paper Industry

Pantlind Hotel

Grand Rapids, Mich.

Sept. 27–29, 1960

Power Requirements of Supercalenders

Status Report on TAPPI Project No. 368

R. J. FARRELL

Under Project No. 368, the various factors affecting the operating power requirements of supercalenders were established. Test procedures and required data for establishing the quantitative effect of each factor were developed. Future work will require detailed test data from a sufficient wide range of supercalenders to establish the effect of each variable.

THE greatly increased power requirements of the large, high speed supercalenders have made this subject one of considerable economic interest to the paper industry in the design and layout of new operations. The Electrical Engineering Committee of the Engineering Division in reviewing the available data on the factors affecting operating power requirements for supercalenders, found only meager information to be available with some of this information being subject to question.

Because adequate information is not presently available for calculating these power requirements and quantitatively evaluating the effect of the many operating variables, TAPPI established Project No. 368, "Power Requirements of Supercalenders," to ascertain the facts pertinent to the problem.

Under this project TAPPI was to obtain operating data from a representative group of supercalenders, and from these data to establish for the industry the relationship of the various factors involved.

Questionnaires were sent to a representative group of 45 paper mills covering over 200 supercalender installations. Inadequate returns of these questionnaires prompted the Electrical Engineering Committee to contact top management personnel of paper corporations having representative installations with an offer to provide teams of personnel to travel to the mill sites to record these data.

The lack of sufficient will participation in these efforts to provide accurate representative data resulted in the agreement by the Electrical Engineering Committee to terminate this project until such time as sufficient mill participation is available.

Below are recommended procedures and questionnaires to record pertinent data for a supercalender. Mill personnel should be encouraged to record this data in a uniform manner by uniform procedures for their own installations. These data then can serve a useful purpose for equipment selection for mill expansions and modernization. In addition, the availability of these data at enough mills can result in the activation of this project whose ultimate aim is to increase the knowledge to the industry of supercalender power requirements and the factors concerned.

SUPERCALENDER POWER REQUIREMENT

Factors Affecting Power Requirements

The factors affecting the power requirements of a supercalender may be broadly classified as stack condition, stack characteristics, and type and size of wind and unwind. Specifically, these factors can be listed as follows:

Stack Condition
- Type of bottom roll bearings
- Type of top roll bearings
- Type of intermediate roll bearings
- Roll alignment
- Condition of in-drive-gearing

Stack Characteristics
- Face width
- Speed
- Number of filled roll nips
- Pressure gradient
- Roll arrangement
- Roll hardness—measured on Shore Durometer D scale
- Type of filled roll
- Type and weight of paper

Type of Unwind
- Friction
- Electrical

Type of Winder
- Stack Driven
- Electrical

In the recording of data the mechanical condition of the stack and the type and size of unwind must be considered to determine the actual amount of power input to the stack for normal running conditions.

Once these factors have been properly evaluated, it becomes highly desirable to determine an approximate formula for the horsepower required to drive a supercalender expressed as follows:

$$H.P. = W \times \frac{F.P.M.}{100} \times \frac{K.}{\text{No. rolls}} \times \frac{Kp}{\text{Bottom nip pressure}} \times Kr$$

$W.$ = face width, in.
$F.P.M.$ = speed, feet per minute
K = factor determined by number and arrangement of rolls
Kp = factor determined by bottom nip pressure, lb./in.
Kr = filled roll factor determined by type and hardness of roll

Procedure for Recording Mechanical Data

Figures 1 and 2 are sample copies of questionnaires which may be used as guides by mill personnel for recording and evaluating data for their supercalender installations.

Mill records or supercalender manufacturers' records can be consulted to evaluate the mechanical characteristics of the stack. The following data should be recorded:

1. Face of calender.
2. Number of rolls and arrangement of these rolls.
3. Diameter of rolls and type of rolls, i.e., whether chilled iron or filled, type of filling, hardness of rolls, number of steam rolls or water-cooled rolls. Durometer readings for filled rolls prior to installation in the supercalender and Durometer readings at the time of test should be recorded.
4. Type of bearings, maker, and bearing number of every roll.
5. Weight of each roll with its bearings and housings.
6. Type of loading and pertinent information, hydraulic, pneumatic with area of cylinder at each end of cylinder, leverage, etc. To determine lb./in. nip pressure from the pressure gage readings.
7. Information on drive of calender, such as maximum and minimum speed available.
8. Information on unwind and rewind, such as, type, maximum mill roll diameter, core size.

R. J. FARRELL, Reliance Electric and Engineering Co., 24701 Euclid Ave. Cleveland, Ohio

SUPERCALENDER POWER DATA QUESTIONNAIRE

TAPPI ENGINEERING DIVISION PROJECT

COMPANY_____ LOCATION _____

TYPE OF STACK_____ YEAR INSTALLED_____

FACE_____

MAXIMUM SPEED (Designed)_____

MAXIMUM BOTTOM ROLL NIP PRESSURE (Designed)_____

DEAD WEIGHT OF ROLLS ON BOTTOM NIP (No Added Pressure)_____

NUMBER OF STEEL OR CHILLED IRON INTERMEDIATE ROLLS_____

NUMBER OF FILLED ROLLS_____

ROLL ARRANGEMENT (Complete Spaces For Applicable Number Of Rolls) _____

	Steel Or Chilled Iron	Type Of Filled Roll (1)	Filled Roll Harness (2)	Anti-Friction Or Sleeve Bearing	Steam Or Water Joint	Comments
Top	S					
DIAM. Bottom	S					

(1) Cotton, paper, etc

(2) Durometer rating, filmat number, or other indication.

Fig. 1A

TYPE OF UNWIND_____

CORRELATION OF DATA TO ASSIST IN DETERMINING SHEET TENSION

IE.. IF ELECTRIC MOTOR: RATING_____HP._____VOLTS_____AMPS._____

_____

_____

TYPE OF WINDUP_____

CORRELATION OF DATA TO ASSIST IN DETERMINING SHEET TENSION

IE. IF ELECTRIC MOTOR: RATING_____HP._____VOLTS_____AMPS._____

_____

_____

TYPE OF STACK DRIVE _____

MOTOR RATED_____ HP._____VOLTS_____AMPS._____

CONDITION OF GEARING _____

_____

_____

CORRELATION OF DATA TO ASSIST IN DETERMINING TOTAL BOTTOM NIP PRESSURE

DIAL PRESSURE_____CORRESPONDS TO_____ APPLIED PRESSURE ON RIGHT SIDE

DIAL PRESSURE_____CORRESPONDS TO_____ APPLIED PRESSURE ON LEFT SIDE

OR DIAL PRESSURE_____CORRESPONDS TO_____BOTTOM NIP PRESSURE RIGHT SIDE

DIAL PRESSURE_____CORRESPONDS TO_____BOTTOM NIP PRESSURE LEFT SIDE

OR MECHANICAL LOADING DATA _____

_____

_____

Fig. 1B

QUESTIONNAIRE OF POWER REQUIREMENTS ON SUPERCALENDERS

A. NO PAPER

SPEED	PRESSURE*	MOTOR AMPS.	MOTOR VOLTS	COMMENTS
Thread ___ Fpm.	___ Dead Weight			
1/3 ___ Fpm.	___ Dead Weight			
2/3 ___ Fpm.	___ Dead Weight			
Top ___ Fpm.	___ Dead Weight			
Thread ___ Fpm.	___ 70% Total Bottom Nip			
1/3 ___ Fpm.	___ 70% Total Bottom Nip			
2/3 ___ Fpm.	___ 70% Total Bottom Nip			
Top ___ Fpm.	___ 70% Total Bottom Nip			
Thread ___ Fpm.	___ 100% Total Bottom Nip			
1/3 ___ Fpm.	___ 100% Total Bottom Nip			
2/3 ___ Fpm.	___ 100% Total Bottom Nip			
Top ___ Fpm.	___ 100% Total Bottom Nip			

* EXPRESS PRESSURE IN TERMS THAT CAN BE EVALUATED INTO BOTTOM NIP PRESSURE IN LBS/LINEAR INCH WIDTH.

Fig. 2A

QUESTIONNAIRE OF POWER REQUIREMENTS ON SUPERCALENDERS

B. WITH PAPER

TYPE SHEET_____WT._____LBS/3000 SQ. FT. COATED OR UNCOATED_____ SHEET WIDTH _____

SPEED	PRESSURE *	CALENDER Motor Amps.	CALENDER Motor Volts	UNWIND ** Motor Amps.	UNWIND ** Motor Volts	WIND ** Motor Amps.	WIND ** Motor Volts
Thread ___ Fpm.	___ Dead Weight						
1/3 ___ Fpm.	___ Dead Weight						
2/3 ___ Fpm.	___ Dead Weight						
Top ___ Fpm.	___ Dead Weight						
Thread ___ Fpm.	___ 70% Total Bottom Nip						
1/3 ___ Fpm.	___ 70% Total Bottom Nip						
2/3 ___ Fpm.	___ 70% Total Bottom Nip						
Top ___ Fpm.	___ 70% Total Bottom Nip						
Thread ___ Fpm.	___ 100% Total Bottom Nip						
1/3 ___ Fpm.	___ 100% Total Bottom Nip						
2/3 ___ Fpm.	___ 100% Total Bottom Nip						
Top ___ Fpm.	___ 100% Total Bottom Nip						

* EXPRESS PRESSURE IN TERMS THAT CAN BE EVALUATED INTO BOTTOM NIP PRESSURE IN LBS/LINEAR INCH WIDTH.

** IF WIND AND UNWIND ARE MECHANICAL OR HYDRAULIC, USE THESE SPACES TO GIVE A FAIR EVALUATION OF SHEET TENSION IN LBS/INCH WIDTH

Fig. 2B

QUESTIONNAIRE OF POWER REQUIREMENTS ON SUPERCALENDERS

C. UNUSUAL CONDITIONS _____ WITH OR _____ WITHOUT PAPER

SPEED	PRESSURE	CALENDER Motor Amps.	CALENDER Motor Volts	UNWIND Motor Amps.	UNWIND Motor Volts	WIND Motor Amps.	WIND Motor Volts
___ Fpm.							
___ Fpm.							
___ Fpm.							
___ Fpm.							
___ Fpm.							
___ Fpm.							
___ Fpm.							
___ Fpm.							
___ Fpm.							
___ Fpm.							
___ Fpm.							
___ Fpm.							

USE THIS SHEET TO LIST DATA ON STACK LOADING UNDER CONDITIONS OF EXCESSIVE PRESSURES, SPEEDS, ROLL HARDNESS OR SOFTNESS, HEAVY SHEET WEIGHTS, ETC. SUCH DATA WILL BE USED TO EXTEND NORMAL LOADING CURVES FOR FUTURE CONSIDERATIONS.

COMMENTS_____

_____

_____

_____

Fig. 2C

Procedure for Recording Electrical Data

1. The following metering equipment in addition to that supplied on the drive should be available.
   Portable multimeter—Simpson Triplett, or equivalent
   Integrating speed-indicating tachometer
2. Obtain nameplate data on all calender drive equipment including motors, main generators, calender-driven generators, booster generators, etc. This would include windup and unwind drives, as well as the main stack drive. (Does not include a.c.-drive motors.)
3. Make sure that adequate instrumentation is available for taking tests and check calibration. A 5 to 10% error in calibration can probably be tolerated.
4. Draw a sketch of the complete armature loop showing all of the d.c.-drive motors, generators, boosters, calender-driven generators, etc. Any required explanatory notes should be given on the sketch.
5. For each running condition, a complete set of electrical readings and calender speed should be taken of drive equipment voltage and amperes. If possible, a number of different instruments should be used to facilitate reading.

Procedure for Analyzing Data

1. Convert all electrical readings into *H.P.* input to the driven rolls.

$$H.P. = \text{Rated } H.P. \times \frac{\text{Test volts}}{\text{Rated volts}} \times \frac{\text{Test amp.}}{\text{Rated amp.}}$$

2. On windup and unwind the calculated *H.P.* should also be converted into sheet tension. If the drive arrangement is good mechanically, assume about 10% losses in order to determine sheet tension (S.T.).

$S.T.\ H.P.$ Windup = Input $H.P.$ − 10%
$S.T.\ H.P.$ Unwind = Output $H.P.$ + 10%

$$S.T. = \frac{\text{S.T. H.P.} \times 33{,}000}{W \times N} \text{ lb./in.}$$

Where:

$S.T.\ H.P.$ = Sheet-tension horsepower
W = Calender width, in.
N = Calender speed, f.p.m.

3. Windup and Unwind $H.P.$ should be converted to hp. per width per 100 f.p.m. This will allow taking all data on windup and unwind power requirements and plotting a drive constant versus sheet tension.
4. Calculate the net power into the stack.

Stack $H.P.$ − Main Drive $H.P.$ input + Windup $H.P.$- Unwind $H.P.$

5. The net power into the stack should be converted to a constant in terms of hp. per in. width per 100 f.p.m.
6. Curves should be plotted of $H.P.$ versus speed for constant bottom nip pressures. These data should be recorded without paper and with different basis weights of paper.
7. Curves should be plotted of $H.P.$ versus bottom nip pressure for constant line speeds. These data should be recorded without paper and for different basis weights of paper.

Presented by title at the 14th Engineering Conference of the Technical Association of the Pulp and Paper Industry, held in Pittsburgh, Pa., Oct. 12–15, 1959.

Recommended Practices and Purchase Specifications for Medium Voltage Motor Controllers (2300 to 5000 volts a.c.) for the Pulp and Paper Industry

TAPPI Project No. 686

H. A. WRIGHT

Under Project 686 various construction features and performance requirements felt desirable by mill operating personnel were studied by a subcommittee of the Electrical Engineering Committee. The results of this study have been assembled into coordinated form for use by the industry when considering the purchase of new equipment.

THESE recommended practices have been written by a Subcommittee of the Electricl Engineering Committee of the TAPPI Engineering Division. They are based on a questionnaire which was circulated to all user members of the Electrical Engineering Committee.

These recommended practices are in agreement with applicable National Electrical Manufacturers Association (NEMA) Standards, and contain additional festures which are desired by users.

1. ENCLOSURE

1.1 Description
a. For indoor installation the enclosure shall be general purpose NEMA 1. Bottom plates will not be required.
b. For outdoor installation the enclosure shall be weather resistant NEMA Type 3 having bottom plates. All openings to be gasketed to exclude dust, wind-driven snow and rain. The gaskets around the doors are to be held in channels. Thermostatically controlled space heaters should be provided. The bottom of the cubicle will be undercoated with a bituminous compound. Likewise the joining sides of units in a group lineup.
d. Material which will support combustion shall be kept to a minimum.

1.2 Dimensions
Basic enclosure shall have a height of 90 in. exclusive of mounting sills. Floor area to be kept at a minimum consistent with accessibility for maintenance.

1.3 Power and Control Leads
Space for conduit or armored cable entrance shall be provided at top and bottom.
a. Provision for enclosing and isolating motor leads when entering at top through high voltage compartment. (At times motor cables are pulled in with the buss hot.)

1.4 Location of Resistors
Resistors which require ventilation shall be mounted in a ventilated portion of the enclosure, preferably on top or externally mounted.

1.5 Compartments
Meters, instruments, relays, test blocks and other low-voltage equipment shall be in a separate compartment and segregated from high voltage equipment.

1.6 Construction
Construction shall be such that all maintenance and installation work may be performed from the front.

1.7 Steel for Enclosure
Steel plate used will be at least 12 gage, with 11 gage, preferred.

2. POWER BUSSES

2.1 Rating
The power bus will have a continuous rating of 1000 amp. unless a larger capacity is specified. It will be braced to withstand the momentary short circuit forces exerted by a system capable of 60,000 amp. RMS asymmetrical.

2.2 Location
Busses, if specified, shall be on top of the control enclosure at the front. All manufacturers shall locate the busses in the same position so controllers of different manufacturers can be mounted adjacent to each other and the busses can be easily connected between controllers (see Fig. 1).

2.3 Enclosure
Buss compartment shall be isolated from the controller.

2.4 Splices
Buss bar splices shall be silver plated and joined with at least two bolts.

2.5 Ground Buss
When controllers are assembled into groups, a ground buss shall be furnished.

3. ISOLATING DEVICE

3.1 Description
The isolating device shall be a three-pole, gang-operated isolating switch. With compartment door open, the blades shall be visible and grounded when open.

3.2 Padlocking
Provision shall be included to accommodate three padlocks for locking the switch in the open position.

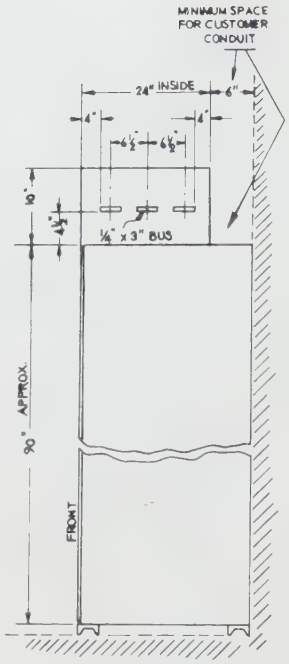
3.3 Operation
The operating handle of this switch shall be outside of the compartment.

4. INTERRUPTING RATING

4.1 Interrupting Rating
The interrupting rating shall be at least 150,000 kva. at 2300 v., and 250,000 kva. at 4600 v.

4.2 Description

H. A. WRIGHT, Allis-Chalmers Mfg. Co., West Allis, Wis.



Note 1: This sketch applies to NEMA 1 enclosure only. It does not appear feasible to put buss on top of a NEMA 3 enclosure.

Note 2: Since manufactured controllers vary in depth from 30 to 32 in. the base line will be the front of the enclosure. The 6-in. dimension for customers conduit is the minimum dimension.

Fig. 1

Power fuses, if used, shall be current limiting type. They will be mounted behind doors mechanically interlocked to the isolating switch (see Section 7).

4.3 Selection
Fuses shall be properly sized and coordinated with the thermal overload relays.

5. CONTACTORS

5.1 Description
Contactors shall be of the air-break type and not mechanicaly latched in the closed position.

a. They shall be either removable or readily accessible.
b. Terminal boards for coil leads and control wiring shall be easily accessible.
c. The standard is air; however under certain atmospheric conditions oil may be more desirable.

6. ACCESSIBILITY

6.1 Accessible from Front
All functioning parts of the controller shall be readily accessible for maintenance or replacement from front of the contactor.

6.2 Low Voltage Panel
Low voltage panel shall either be front wired, hinged, or otherwise accessible for maintenance and inspection of all wiring. To facilitate maintenance a removable panel is preferred.

6.3 Terminal Boards
All terminals for outgoing low voltage conductors to be at least 12 in. from floor and readily accessible for connection and identification. Sufficient space shall be provided for routing of customer's control wiring, segregated from high-voltage leads, to such terminal boards.

7. INTERLOCK REQUIREMENTS

7.1 Isolating Switch and Compartment Door
Isolating switch must be open before any high-voltage compartment door can be opened and cannot be closed before all such compartment doors have been closed.

7.2 Isolating Switch and Contactors
It shall not be possible to open or close the isolating switch while any line contactors are closed or control transformer is under load.

7.3 Provision for Testing
Provision shall be made so that controller can be operated from a separate 220-v. source for testing but only with main isolating switch and control transformer secondary open.

7.4 Type of Interlocks
Mechanical type interlocks of the interference type are preferred over key-type interlocks. Some means shall be provided for gaining entry to the enclosure in case a contactor should weld closed.

8. PROTECTIVE DEVICES AND CONTROL CIRCUITS

8.1 Protective Devices
Control shall include control devices such as undervoltage relay, overload relays, field application where required, etc., which are recognized as necessary for adequate protection to personnel and equipment.

a. Overload protection shall be furnished by means of a thermal overload relay in each phase; temperature compensated relays are preferable.

8.2 Excitation Failure
Field failure protection shall be provided for all synchronous motors and is to be operated on loss of d.c. excitation current.

8.3 Number of External Wires
Control circuit shall be designed so that a minimum number of external devices are required.

8.4 A.C. Control Circuit
When a.c. control is required, it shall be supplied by a control transformer on each controller, 220 v. secondary. It shall be supplied from the load side of the main disconnect through its own current limiting fuses. A.C. control shall also be provided with disconnecting means and overcurrent protection on secondary side. Provision shall be made for grounding one side of secondary of control transformer and where ground bus is specified this connection shall be made to the ground bus.

8.5 D.C. Control Circuit
When d.c. control is required it shall be supplied through a disconnecting switch and fault-current protective means furnished as part of the controller. When d.c. excitation is required the controller shall include means for disconnecting, short-circuit protection, and adequate field-discharge protection. Adequate field-discharge protection is understood to include a discharge means permanently connected across the load side of the circuit protective device, in addition to any other resistors which may be connected to the field circuit on occasion by discharge clips or normally closed contacts.

8.6 Stall Protection
Controllers for wound rotor motors driving chippers or other loads subject to stalling may require protection against stalled conditions. Since this requirement varies with the drive and motor characteristics, each should be handled on its own merits.

8.7 Wire
All control wire shall be stranded with flame retardent insulation.

8.8 Undervoltage Protection
Instantaneous undervoltage protection shall be furnished unless time-delay is specified.

8.9 Fusing of Potential Transformer
Potential transformers, if furnished, shall be fused on the primary side with current limiting fuses.

8.10 Pushbuttons
When used, will be oiltight. Red for stop, black for start.

8.11 Indicating Lights
When used, will be oiltight, transformer operated with 6 to 8-v. bulbs.

9. NAMEPLATES

9.1 Description
Permanent and legible markings shall be provided for all devices, with designations according to NEMA Standards 1C1-3.01.

9.2 Power Fuse Designation
Nameplate showing catalog number of power-circuit fuses used shall be mounted on inside of fuse compartment door.

10. CONNECTION DIAGRAM

10.1 Location of Contacts in Control Circuit
On schematic diagram, all contacts to be on left-side of coils except overload contacts and emergency stop switches which break both sides of line.

10.2 General Requirements
Connection diagram shall include schematic and panel diagram.

10.3 Identification
All wiring diagrams shall be clearly identified with equipment to which it applies.

11. OPTIONAL FEATURES

11.1 Instruments
Instruments, instrument transformers, and test blocks shall be optional with customer.

11.2 Pushbuttons and Indicating Lights (see Section 8.10 and 8.11)

11.3 Other (To be specified by the user)

Presented by title at the 14th Engineering Conference of the Technical Association of the Pulp and Paper Industry, held in Pittsburgh, Pa., Oct., 12–15. 1959.

Recommended Practices and Purchase Specifications for Rear and Front Access Type Medium Voltage Motor Controllers (2300 to 5000 volts a.c.) for the Pulp and Paper Industry

TAPPI Project No. 686

H. A. WRIGHT

Under Project 686 various construction features and performance requirements felt desirable by mill operating personnel were studied by a subcommittee of the Electrical Engineering Committee. The results of this study have been assmbled into coordinated form for use by the industry when considering the purchase of new equipment.

These recommended practices have been written by a Subcommittee of the Electrical Engineering Committee of the TAPPI Engineering Division. They are based on a questionnaire which was circulated to all user members of the Electrical Engineering Committee.

These recommended practices are in agreement with applicable National Electrical Manufacturers Association (NEMA) Standards and contain additional features which are desired by users.

H. A. Wright, Allis-Chalmers Mfg. Co., West Allis, Wis.

1. ENCLOSURE

1.1 Description

a. For indoor installation the enclosure shall be general purpose NEMA 1. Bottom plates will not be required.
b. For outdoor installation the enclosure shall be weather resistant NEMA Type 3 having bottom plates. All openings to be gasketed to include dust, wind-driven snow and rain. The gaskets around the doors are to be held in channels. Thermostatically controlled space heaters should be provided. The bottom of the cubicle will be undercoated with a bituminous compound. Likewise the joining sides of units in a group lineup.

1.2 Dimensions
Manufacturers dimensions on this class of equipment vary. It is up to the user to select those most suitable to his application.

1.3 Power and Control Leads
Space for conduit or armored cable entrance shall be provided at top and bottom.

a. Provision for enclosing and isolating motor leads when entering at top through high voltage compartment. (At times motor cables are pulled in with the buss hot.)

1.4 Location of Resistors
Resistors which require ventilation shall be mounted in a ventilated portion of the enclosure, preferably on top or externally mounted.

1.5 Compartments
The enclosure will be divided into threeco mpartments:

a. High voltage fuse compartment accessible from front.
b. Low voltage control compartment accessible from front.
c. High voltage control compartment accessible from rear.

1.6 Construction
Construction shall be such that all maintenance and installation work may be performed from the front and rear.

1.7 Steel for Enclosure
Steel plate used will be at least 12 gage, with 11 gage preferred.

2. POWER BUSSES

2.1 Rating
The power buss will have a continuous rating of 1000 amp. unless a larger capacity is specified. It will be braced to withstand the momentary short-circuit forces exerted by a system capable of 60,000 amp. RMS asymmetrical.

2.2 Location
Busses, if specified, may be on top or in the upper portion of the high voltage compartment.

2.3 Enclosure
Buss shall be isolated from the controller by means of a steel buss cover.

2.4 Splices
Buss bar splices shall be silver-plated and joined with at least two bolts.

2.5 Ground Buss
When controllers are assembled into groups, a ground buss shall be furnished.

3. ISOLATING DEVICE

3.1 Description
The isolating devices shall consist of three single-pole disconnecting type fuse holders.

3.2 Padlocking
Provision shall be included to accommodate three padlocks for locking the high voltage compartment doors.

3.3 Operation
The disconnecting type fuse holders shall be operated by means of a hook stick, with fuse holder readily removable.

4. INTERRUPTING RATING

4.1 Interrupting Rating
The interrupting rating shall be at least 150,000 kva. at 2300 v. and 250,000 kva. at 4600 v.

4.2 Description
Power fuses shall be current limiting type. They will be mounted behind doors electrically interlocked to the main contactor (see Section 7).

4.3 Selection
Fuses shall be properly sized and coordinated with the thermal overload relays.

5. CONTACTORS

5.1 Description
Contactors shall be of the air-break type and not mechanically latched in closed position.

a. They shall be either removable or readily accessible.
b. Terminal blocks for coil leads and control wiring shall be easily accessible.
c. Air contactors are preferred, but oil contactors may be used for special environmental applications.

6. ACCESSIBILITY

6.1 Accessible
All functioning parts of the controller shall be readily accessible for maintenance or replacement.

6.2 Low Voltage Panel
Low voltage control panel shall either be front wired, hinged, or otherwise accessible for maintenance and inspection of all wiring.

6.7 Terminal Blocks
All terminals for outgoing low voltage conductors to be at least 12 in. from floor and readily accessible for connection and identification. Sufficient spaces shall be provided for routing of customer's control wiring, segregated from high voltage leads, to such terminal blocks.

7. INTERLOCK REQUIREMENTS

7.1 Fuse Compartment Door and Line Contactor
An electrical interlock is to be provided in such a manner that opening the fuse compartment door will interrupt the operating coil circuit of the line contactor to prevent the opening of line disconnects while carrying load.

7.2 Provision for Testing
Provision shall be made so that controller can be operated from a separate control power source for testing. When testing from a separate power source, the control transformer secondary must be disconnected.

8. PROTECTIVE DEVICES AND CONTROL CIRCUITS

8.1 Protective Devices
Control shall include control devices such as control relay, overload relays, field application where required, etc., which are recognized as necessary for adequate protection to personnel and equipment.

8.2 Excitation Failure
Field failure protection shall be provided for all synchronous motors and is to be operated on loss of d.c. excitation current.

8.3 Number of External Wires
Control circuit shall be designed so that a minimum number of wires to external devices are required.

8.4 A.C. Control Circuit
When an a.c. control is required, it shall be supplied by a control transformer in each controller. A 220-v. secondary control voltage is preferred. The control transformer shall be connected from the load side of the main disconnect through its own current limiting fuses. A. C. control shall also be provided with disconnecting means and overcurrent protection on secondary side. Provision shall be made for grounding one side of the secondary or center tap of the control transformer and where ground bus is specified this connection shall be made to the ground bus.

8.5 D.C. Control Circuit
When d.c. control is required it shall be supplied through a disconnecting switch and fault-current protective means furnished as part of the controller. When d.c. exictation buss is required the controller shall include means for disconnecting, short-circuit protection, and adequate field-discharge protection. Adequate field-discharge protection is understood to include a discharge means permanently connected to the field circuit on occasion by discharge clips or normally closed contacts.

8.6 Stall Protection
Controllers for wound rotor motors driving chippers or other loads subject to stalling may require protection against stalled conditions. Since this requirement varies with the drive and motor characteristics each should be handled on an individual basis.

8.7 Wire
All control wire shall be stranded withfla me-retardent insulation.

8.8 Undervoltage Protection
Instantaneous loss of voltage protection is preferred but time-delay loss of voltage protection may be specified when required.

8.9 Fusing of Potential Transformers
Potential transformers, if furnished, shall be fused on the primary side with current limiting fuses.

8.10 Pushbuttons
When used, will be oiltight. Red for stop, black for start.

8.11 Indicating Lights
When used, will be oiltight, transformer operated with 6-to 8-v. bulbs.

9. NAMEPLATES

9.1 Description
Permanent and legible markings shall be provided for all devices, with designations according to NEMA Standards 1C1-3.01.

9.2 Power Fuse Designation
Nameplate showing catalog number of power-circuit fuses used shall be mounted on inside of fuse compartment door.

10. CONNECTION DIAGRAM

10.1 Location of Contacts in Control Circuit
On schematic diagram all contacts to be on left-hand side of coils except overload and other protective device contacts and emergency stop switches which break both sides of line.

10.2 General Requirements
Connection diagram shall include schematic and panel diagram.

10.3 Identification
All wiring diagrams shall be clearly identified with the equipment to which it applies.

11. OPTIONAL FEATURES

11.1 Instruments

Instruments, instrument transformers, and test blocks shall be optional as required.

11.2 Pushbuttons and Indicating Lights (see Section 8.10 and 8.11).

11.3 Other (to be specified by the user).

Presented by title at the 14th Engineering Conference of the Technical Association of the Pulp and Paper Industry, held in Pittsburgh, Pa., Oct. 12–15, 1959.

Wet End Electric Helper Drives for Fourdrinier Machines

TAPPI Project No. 748

D. C. PIER and S. J. CAMPBELL

THE fourdrinier sections of most new paper machines include several driven rolls. In the past a single indrive, usually on the couch roll, was sufficient. Today additional indrives are added to the wire because of new fourdrinier designs, and as a result, higher safe operating speeds, higher tonnages, and increased wire life are achieved. Typical current examples of lineshaft driven machines with additional indrives on the fourdrinier section are shown in Table I.

Table I

Paper machine			*Fourdrinier indrives*		
Width, in.	*100% f.p.m.*	*Paper*	*Total no.*	*Auxiliary no.*	*indrives total hp.*
282	3000	News	4	3	400
234	3000	Kraft	5	4	395
160	1500	Book	5	4	140
270	2000	Kraft	7	6	450

These additional indrives are commonly known as helper drives. A helper drive can be defined as an auxiliary power input to a machine section, the speed of the section being determined by a primary indrive. The primary indrive can be a mechanical drive from a lineshaft or the main regulated motor of an electrical sectional drive.

REASONS FOR HELPER DRIVES

The machine builder, in conjunction with mill officials, will usually make the decision whether to use helper drives when he lays out the wet end section of the paper machine. He will also, at this time, determine what ratings to use at the various indrives where he has decided to apply helper drives. Reasons for applying electric helper drives to the wire section of a machine are:

1. To provide for the total power input required by the fourdrinier. The principal reasons for this use of multiple indrives are the increasing use of pickups, and the practice of taking the sheet off an open run of the wire rather than directly off the couch roll. These practices have made it necessary to design fourdriniers with a turning roll or forward roll. Because of reduced wrap on the couch and because there is no vacuum on the turning roll, the drive abilities of both rolls are reduced. It has thus become necessary to distribute the total load among two or more indrives. Also, there is strong evidence that there is less wire wear when power is applied through a smooth roll rather than through a drilled suction roll. Therefore, it is advantageous to keep the drive load on the couch roll to a minimum.

2. The modernization or speedup of existing machines may result in increased power requirements at the fourdrinier section and also in changes in the wire run. At this time the machine builder or the user may decide to add helper drives, either to reduce the loading on the lineshaft indrive, or to provide extra indrives to the fourdrinier.

D. C. PIER, Beloit Iron Works, Beloit, Wis.; and S. J. CAMPBELL, Westinghouse Electric Corp., East Pittsburgh, Pa.

3. To allow, in some cases, operating the fourdrinier for slow speed or washup conditions without having to jog through the section clutch.

LOCATION AND TYPES HELPER INDRIVES

The questions of whether to use helper drives and what rating to use for the particular helper drive motor are decided on the basis of one or more of the following considerations:

1. On new machines helpers may be applied to rolls located on the bottom run of the fourdrinier wire, with the horsepower rating being a function of the wrap of the wire about the roll and the desired wire tension each side of the particular roll, and the machine speed. Also, for a modern fourdrinier section with a driven couch and a driven wire turning roll, the present practice is almost invariably to provide an electric helper drive on the couch roll and the lineshaft or section electric indrive on the wire turning roll.

The various arrangements used on the fourdrinier helper drives are as follows:

(a) Helper on couch only.
(b) Helpers on couch and turning roll.
(c) Helper on couch and small helper on 1st return roll.
(d) Helpers on couch, on two return rolls, size based on torque ability of return rolls.
(e) Helpers on couch and three return rolls, size again being based on torque ability of return rolls.

2. On older lineshaft driven machines, a helper drive may be applied to an existing indrive to allow increased power input to the section without having to revamp the lineshaft parts.

TYPICAL HELPER DRIVE SYSTEM

A typical helper drive consists of one or more d.c. motors and gears coupled to the driven rolls and a d.c. power supply which may be static or a d.c. generator. The d.c. generator is driven from the lineshaft itself or from a separate motor-generator set.

On new machines, lineshaft driven generators are usually but not necessarily used if the lineshaft is driven by a turbine. Motor-generator sets or static power supplies are used when the lineshaft is driven by a d.c. motor. The latter case requires that the helper drive take power direct from the a.c. supply in the mill and in general will cost slightly more than a lineshaft driven generator system. It may or may not be necessary to provide d.c. power supply capacity equal to the sum of the ratings of the helper motors. When several helper drives are applied to a Fourdrinier section, load diversity is used and the drive supplier follows the machine builder's recommendations on total helper loading to select the rating of the power supply. It is common practice where three or more motors of nearly the same size are connected to a single generator, to base the generator capacity on 80% of the total capacity of the motors. The helper drive also includes a control station located at the wet end of the machine, and a d.c. control cubicle with the necessary regulator and magnetic controls.

Specific Functions of the Helper Drive Control

Any helper drive that is supplied to the wire section of a lineshaft driven paper machine must meet the following requirements:

1. The operation of the helper drive should be as automatic as possible in conjunction with the operation of the section air clutch on starting and stopping. This is a must because the remainder of the machine, since it is mechanically driven, will have certain procedures to be followed in starting and stopping. These procedures should not be departed from radically in the case of a section that includes helpers.

2. Since the remainder of the machine, being mechanically driven, will not trip out on slight overloads, the helper drive should be arranged so that it will not trip out on the same

type of overloads. However, there must be some means available for the operators and electricians to correct slight overloads on helper drives without having to shut down the section.

3. The helper drives should automatically adjust to the proper loads under the conditions of stock-on and stock-off on the fourdrinier section.

4. There should not be any slippage of the helper driven rolls during starting, stopping, running, and conditions of stock-on and stock-off.

5. The helper drives should not require continuous attention from the operator after the machine has been put into production.

Typical Helper Drive for One Indrive System

The simplest type of fourdrinier helper drive is one in which only one roll is helper driven, with the other main roll of the section being driven from the lineshaft. A typical example of this would be a couch helper on a two indrive fourdrinier.

The status of the helper drive and its associated control and regulator during the conditions of standstill, starting, running, and stopping will be examined.

When the fourdrinier section is shut down, the d.c. motor is at rest, and the section clutch is open. The lineshaft and helper drive generator are rotating. The terminal voltage of the helper generator is set at zero, and the armature contactor between helper motor and generator is open.

To start the fourdrinier section, the machine tender moves the clutch operating handle, and will expect that the entire fourdrinier section come up to speed with no severe starting torques, minor torque changes during acceleration, and minor transient torque peaks at the instant the section reaches production speed. The stock has not been put on the wire. Therefore, the helper drive must automatically be adjusted for light load operation. If the helper tries to exert full load torque, slippage will result between the couch roll and the wire.

The sequence of operation is as follows:

1. Referring to Fig. 1, the machine tender moves the turning roll clutch valve handle to the run position. A pressure switch in the air line to the clutch energizes the helper armature contactor. At the same time an auxiliary contactor closes, energizing a solenoid valve, which admits air to the clutch.

2. Closing the air clutch causes the fourdrinier section to accelerate. During acceleration the generator voltage is raised gradually so that the helper motor will develop a limited amount of torque to help accelerate the couch roll. When acceleration has been completed, that is, when the air clutch is completely closed, the helper drive develops approximately the torque which corresponds to the power required to drive the couch roll when there is no stock on the wire. For an average couch, this power is approximately 0.004 hp. per inch width per 100 f.p.m. of machine speed.

3. The machine is now up to speed and stock is put on the wire. The torque exerted by the helper motor is increased automatically as load is increased on the entire Fourdrinier section. This automatic increase in helper drive torque is obtained by means of a cue from the vacuum buildup in the couch roll or from the buildup of the torque load on the mechanical indrive. Most older helper drives in operation today are cued from a couch vacuum-operated rheostat. Recent experience, especially with multiple helper drives, indicates that the use of a torque loading cue from the mechanical indrive provides a better overall indication as to the load setting of the helpers.

4. The basic control system for this type of helper drive includes an armature current regulator. The torque developed by a d.c. machine is proportional to the product of armature current and field flux. The couch motor operates at fixed field which means that its field flux is essentially

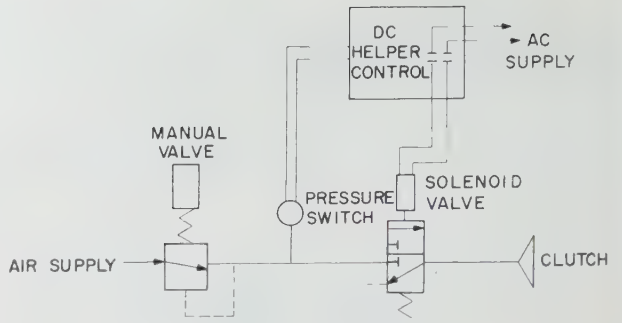


Fig. 1. Clutch-helper interlock system

Operator closes manual air valve; pressure switch energizes helper control and initiates automatic closing of solenoid valve in air line to clutch

constant. The armature current of the couch helper motor is matched to a reference through the regulator. Thus, by regulating the armature current, in effect the torque being developed by the motor is controlled. The regulator controls the excitation to the generator which in turn supplies power to the helper motor. An armature circuit ammeter located on the operator's control station provides an indication of the torque being developed by the helper motor. This ammeter, along with a suitable torque indicator for the lineshaft indrive, allows the operators to determine the total loading on the fourdrinier section. The ammeters and the torque indicators are not actually calibrated in lb.-ft., but the readings may be converted to horsepower by the use of curves. The readings are indications of the indrive loadings and are of use in determining the effects of load changes, such as would result from additions of new suction rolls and flat boxes, changes in wire tensions, and changes in basis weight. The readings are also useful in adjusting the distribution of total load between the turning roll drive and the couch helper.

5. To stop the fourdrinier section, the operator manipulates the clutch operating handle in the same manner as when stopping other sections of the paper machine. Moving the clutch handle to the off position opens the air clutch and at the same time opens the armature contactor for the helper drive. The fourdrinier section will then coast to a stop.

6. The overload system for a d.c. helper drive usually includes separate thermal and instantaneous overload relays. The thermal overload relay is arranged to light a light and perhaps sound an alarm when the motor load rises 15 to 25% above rated full load current. When the overload light comes on the operator knows that something has happened to the machine to increase the loading on the helper drive. The light warns him to readjust the helper load setting or to check total load on the fourdrinier so as to reduce the current back to a safe value. This system is satisfactory because with the current regulator, the current will not exceed the regulated value unless there is a malfunction of the control system or unless the operator makes the wrong adjustments in load settings. The instantaneous overload relay is arranged to open the armature contactor and the clutch at the same time. This overload protection is necessary to protect the d.c. motor from abnormal overloads that might occur during starting or running due to say a high starting torque, a frozen bearing, or a tight suction box.

CONTROL SYSTEMS FOR HELPERS USING TWO INDRIVES

In addition to the helper drive on the couch roll, additional helper power may be desired on the wire turning roll along with the lineshaft indrive to this roll. A helper drive on the wire turning roll allows the use of smaller mechanical indrive parts and will permit operating the fourdrinier section for washup and jog operation by using the helper drive only with the clutch open. When a helper motor is applied to the

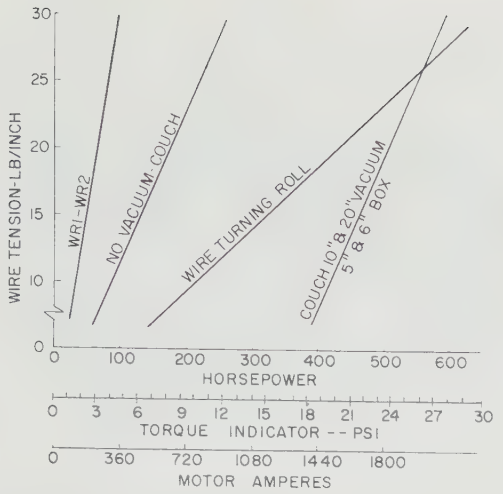


Fig. 2. Maximum drive ability of driven rolls on a typical fourdrinier section; wire tension is measured at slackest point of wire

couch only, there may not be sufficient wrap of the wire about the couch roll to allow driving the wire through the couch roll unless there is stock on the wire, which of course is not the case during jog and washup.

The control system for the two indrive helper is essentially the same as it is for the preceding case of a single indrive helper, in that a single generator supplies power to the two helpers, and a single armature contactor is used. Overload relays, an ammeter and a motor field rheostat are required for the additional helper motor. Also, proper speed-torque characteristics for each of the helper drives are desirable. For example, the couch motor would be built with a slightly flatter speed-torque characteristic than the wire turning roll motor if it were required that the couch motor pick up most of the helper load when the stock is put on the wire.

The features of jog and washup are obtained by means of push-buttons located on the operator's control station. These push-buttons are interlocked so that they will not operate simultaneously with operating the clutch. The control is arranged so that when the fourdrinier is under washup conditions with the helper drive, the clutch can be closed to accelerate the entire drive to production speed.

HELPER DRIVES WITH MORE THAN TWO INDRIVES

A relatively small motor may be used on the wire return roll immediately following the couch roll or the wire turning roll. This motor is rated to provide power to drive the roll

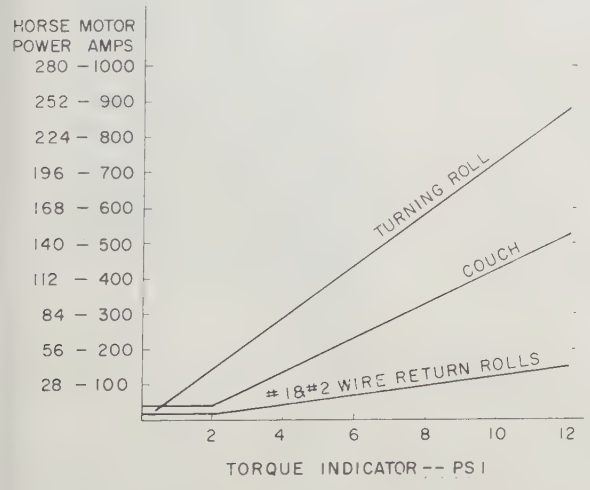


Fig. 3. Distribution of helper motor amperes vs. turning roll torque on a typical fourdrinier for 15 lb./in. wire tension

only, and not necessarily to put substantial power into the wire. The control system for this type of drive is similar to that in the preceding case except that the inch or washup feature by means of the helper drive is not supplied unless there is a helper drive on the wire turning roll.

When the production speed range of the machine is quite large, for example 10:1, the small motor will not pick up load at the low speed, because of the relative values of armature resistance between the large and the small motor. When the resistance drops of the helper motors are of widely different values, a separately driven booster generator set with its armature in series with the smaller motor may be needed to compensate for the larger IR drop.

Recent practice on some new machines is to apply power to one or more return rolls on the bottom run of the fourdrinier wire to help drive the fourdrinier section. This arrangement provides for a higher wire tension on the turning roll, so as to allow the application of more power at the turning roll, which is holding wire speed, and reducing the load required on the couch roll. This system is relatively new. The ratings of the return roll motors are functions of the wrap of the wire around the rolls and the desired tension on the slack side of the rolls. A common practice is to use two or three indrives on the bottom run of the wire with the motors having the same rating as the couch motor, where the drive ability of the return rolls and the expected total load on the fourdrinier allows this combination. The actual size of the motors and the desired load on each may be calculated from the formula:

$$H.P. = \frac{T_1 \times W \times S \times (e^{\mu a} - 1)}{33{,}000}$$

where

T = Slack-side tension (usually 15–30 lb./in. wire width)
W = Machine width, in.
S = Machine speed, in f.p.m. min.
μ = Coefficient of friction (0.25)
a = Angle of wrap, radians

Based on the type of machine, the slack side wire tension may be predicted quite closely. From the Fourdrinier layout, the angle of wrap on the rolls is known. With the calculated values of horsepower ability, a curve may be drawn showing the maximum drive ability vs. wire tension for each driven roll. A typical curve is shown on Fig. 2. It is also possible to draw a curve showing the ideal distribution of loads on all the helpers, either in horsepower at top speed or in amperes, plotted against torque, horsepower, or amperes on the turning roll drive. A typical curve of this type is shown in Fig. 3. The characteristics of the helper drive control may then be designed to meet the ideal conditions shown by the curve. This includes matching of IR drops and of shunt field current settings. Minimum current settings may be established by taking ampere readings on each driven roll with the wire off the fourdrinier. The running current for each motor will then be proportional to the torque required by the turning roll, up to the maximum drive ability of the roll or the rating of the motor. The curves of Fig. 3 show minimum load settings and the range of proportional operation as set up for a typical machine. An automatic wire tension indicator or controller is an important control component when this type of drive arrangement is used.

Since the bottom wire rolls can contribute substantial power to the wire, it is necessary that the load distribution between these two motors and the couch motor be set quite closely, particularly when starting a section from standstill. Proper load settings assure no slippage of driven rolls at the instant of starting or during acceleration. A simple method of obtaining correct load distribution is to use armature circuit resistors, mounted in the d.c. control cubicle, to set the total circuit resistance of each motor so that the proper currents are drawn at low speed and during starting conditions.

In general, the load settings of the various helper drives are made by the machine builder during startup. Rheostats for adjusting load division or total load input from the helper

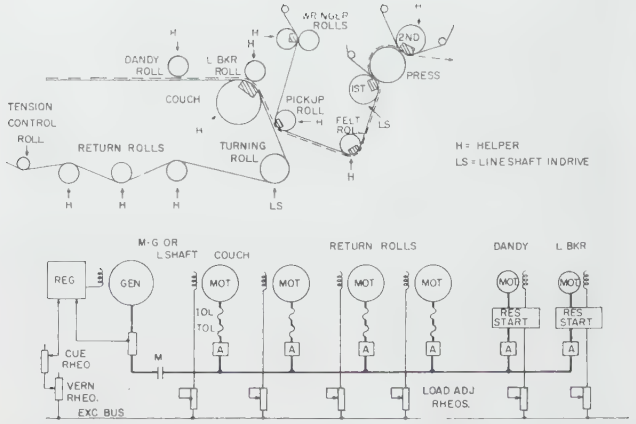


Fig. 4. Fourdrinier and press sections of typical high-speed paper machine, with basic circuits of current-regulated helper drives applied to fourdrinier section

drives are available for use by the operator along with the ammeters. The rheostats are not usually adjusted by the operator unless there is a change in the fourdrinier section, a typical change being a redistribution of wire tension.

There are many methods and combinations of methods for controlling the total torque load and the distribution of torque load on the helper motors. We have chosen to describe above the one which we feel is the easiest to set up, requires the least adjustment by the machine tenders, and still affords a reasonable load distribution over a wide range of total fourdrinier loads. Counter-e.m.f. (CEMF) load regulators as well as current regulators have been applied to fourdrinier helper drives. The CEMF regulator matches motor armature voltage instead of armature current.

DETAILS OF JOGGING, WASHUP, AND ACCELERATION CONTROL

Jogging and slow-speed operation of the wire section are usually accomplished by switching from current to voltage regulation of the helper generator. Where all the helpers are about the same size, it is usually satisfactory to use the same load distribution for jog or slow operation as is used for running operation. Where the couch motor is large compared with the other helpers, special provision must be made for reducing torque on the couch motor because of its low drive ability under jogging or slow speed operation. This can be accomplished by connecting a resistance in series with the armature to reduce couch helper torque. This resistor is shunted by a contactor under running conditions.

In exceptional cases where the couch helper motor is much larger than the turning roll helper drive on a one or two helper indrive, and when mechanical indrive torque is used as the helper cue, there is another problem—when the turning roll clutch is engaged, mechanical drive torque goes to a maximum because of accelerating load. This in turn calls for maximum torque on the couch helper. Since there is no stock on the wire, nor vacuum on the couch, the couch roll has very low drive ability and could slip on the wire. This slippage can be prevented by adding a vacuum switch to the reference circuit of the regulator, so that when couch vacuum is less than 6 in., helper torque is maintained at a low value, regardless of torque on the mechanical drive.

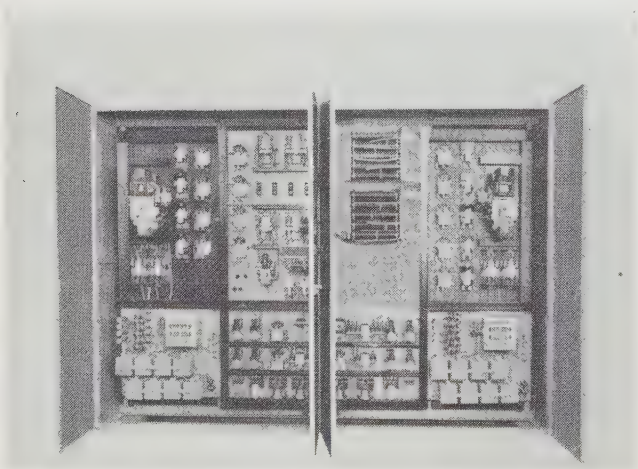


Fig. 5. Magnetic control and regulators in single NEMA I cubicle for fourdrinier and press helper drives on high-speed kraft machine (9 motors totaling 825 hp.)

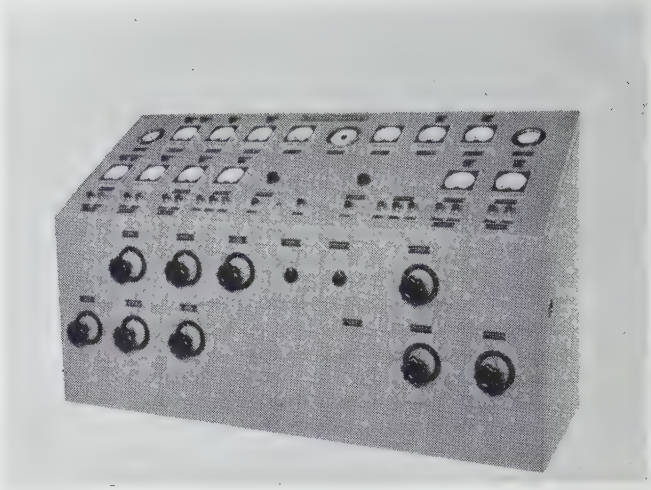


Fig. 6. Helper drive control desk for fourdrinier and press sections, built to match machine builder's desk

Fourdrinier and press lineshaft torque indicators mounted on opposite upper corners. Plastic covers on ammeters protect against moisture and mechanical damage.

HELPER DRIVES FOR DANDY ROLLS AND LUMPBREAKER ROLLS

These rolls are usually separately driven when used on wide and high-speed machines. Separate helpers on these rolls reduce the amount of drive-power that must be transmitted up through the wire and stock. Since the lumpbreaker and dandy rolls are usually raised until stock is on the machine, the helper drives allow these rolls to be rotating when lowered onto the wire, thereby minimizing disturbance to the stock and to the wire.

The main control feature needed for these two helper drives is the ability to be started and stopped independently of the remainder of the helper drives on the fourdrinier section, once the fourdrinier is up to speed. This is done by using a separate resistance type starter for each

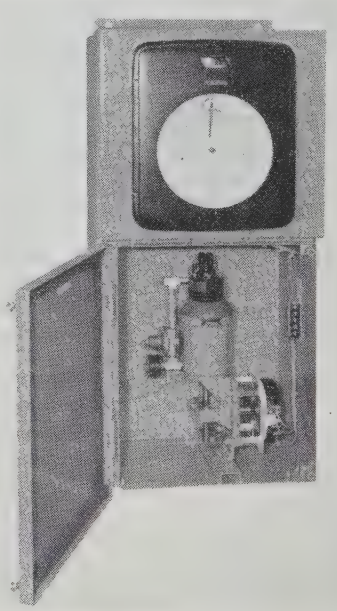


Fig. 7. Vacuum or torque-operated rheostat consists of recorder-controller, pressure regulator, pneumatic operator, and cueing rheostat mounted separately or all in a NEMA I enclosure

motor. Once the rolls are up to speed, they are lowered onto the wire and the desired speed or load setting is obtained by means of the motor field rheostat.

PICKUP AND TRANSFER SECTION HELPER DRIVES

The pickup and transfer section of a suction pickup machine will include helper drives on the pickup roll, wringer roll, and on one or both rolls on the transfer press. This is a common load section because all driven rolls are tied together by the felts or through the roll nips. A common power supply can be used for these helper motors.

The basic helper control system is essentially the same as used with a multiple indrive fourdrinier section. A press felt is a relatively flexible tie as compared to a fourdrinier wire. Thus, it is not necessary to match the armature resistances of the helper motors to assure accurate load divisions during starting and acceleration. Theoretically it is desired to maintain constant torque loading on each helper motor on a pickup felt. This would require that the current of each motor be regulated independent of the other motors, and would result in a complex drive with associated high cost. Experience has shown that, as in the case of cylinder machine helper drives, a single current or CEMF regulator for the entire pickup section will provide satisfactory operation.

The loading practices and method of selecting helper motors and power supplies for pickup sections are listed in TAPPI Data Sheet 145-G.

GENERAL CONSIDERATIONS IN SELECTING CONTROL SYSTEMS

Once it has been decided to apply a helper drive, there are numerous questions that must be resolved, each of which will affect first cost, performance, and maintenance. Typical questions are:

1. How should the air system for motor ventilation be interlocked? D.C. motors applied to the wet ends of paper machines usually are force-ventilated from a common duct system. Suitable interlocking must be provided to assure air flow before starting the drive. This can be done by means of a duct-mounted air switch or by connecting an interlock on the blower starter into the d.c. control. Additional interlocking is required if it is desired to sound an alarm and initiate a shutdown if the air system fails after the machine is put into production.
2. What type of operator's station? Operator's controls are supplied mounted in a desk or on a station for wall or pedestal mounting. NEMA* I enclosures are usually satisfactory. A wall or pedestal mounted control has lowest first cost. The desk type control can be designed to match the appearance and theconfiguration of the machine builder's desks. The machine builder's air controls can be mounted on the helper desk, with a baffle to separate the air and electrical controls. Ammeters and other instruments are more susceptible to moisture when mounted on a desk surface, unless protected by plastic covers.
3. What type of control enclosure? The d.c. control and regulators are usually supplied in a NEMA I enclosure, for location in a control room. Recent practice in some mills is to request open panels, which after locating in a clean ventilated room, permit greater access for inspection and maintenance.
4. How should the vacuum or torque rheostat be supplied? This type of rheostat actually consists of three separate items:
   a. A recorder-controller unit, requiring pipe connections to the couch vacuum or torque indicator, to the regulated air supply, and to the pneumatic operator. Electrical connections may be required for a.c. control voltage.
   b. An air pressure regulator requiring pipe connections to the mill air supply and to the recorder-controller.
   c. A pneumatic operator with pipe connection to the recorder-controller and a mounted rheostat requiring electrical connections to the helper drive d.c. control.

   These three parts can be supplied individually for separate mounting or in a single NEMA enclosure ior wall mounting.

* National Electrical Manufacturers Association.

CONCLUSIONS

Fourdrinier helper drives aid in providing increased wire life, higher tonnages, and higher speeds on new and existing paper machines.

Thus, understanding the functions and the operation of a paper machine helper drive system is becoming more important to the production, quality control and engineering departments, as well as to mill management.

Questions and Answers

Good engineering questions are solicited as well as answers or alternate answers to the published questions. Material should be sent to TAPPI Headquarters, marked for the attention of H. O. Teeple. The items contributed will be forwarded to the Question and Answer Committee for processing. If comments are to be contributed, please refer to the question number.

(1-8/60) *Question:* **We are measuring pH in an open tank, and have a lot of trouble with the calomel electrode plugging. How can I correct this?**

(*1.1-8/60*) *Answer:* The plugging is probably caused by a reverse flow through the calomel electrode tip. There are a few electrode innovations available to solve this problem. An electrode is available which has a rubber hose connection to the KCl reservoir. This hose can be taped to the electrode assembly extension pipe to a point above the tank level. At this point the rubber hose is attached to a bottle of KCl solution. This provides a constant internal pressure in the calomel electrode, thus insuring as outward flow through the electrode tip.

(2-8/60) *Question:* **We are having trouble with stock plugging the bottom connection of the sight glass on our pressurized paper machine headbox. What can be done to prevent the connection from plugging?**

(*2.1-8/60*) *Answer:* A slow purge of clear water at the top of the glass keeps it clean as the water runs down the inside. The flow of water into the headbox keeps the connection at the bottom clean. At least a one-inch diameter sight glass is recommended.

(3-8/60) *Question:* **What type of valve may be used to throttle the flow of lime sludge or other slurries?**

(*3.1-8/60*) *Answer:* Satisfactory operation has been experienced using split body angle-type valves with stellited seat and plugs. The flow enters under the plug and discharges through the side outlet. Valves should be carefully selected to avoid oversizing as better operation is obtained with wider valve openings. Diaphragm and pinch-type valves may be used for on-off service.

(4-8/60) *Question:* **What can be done about oil in an instrument air supply system?**

(5-8/60) *Question:* **Through what chain of authority does a paper mill instrument engineer function most effectively? At what level in the management organizational chain does the instrument engineer function most effectively?**

*(6-8/60) *Question* (Polyphase Wattmeter Reading): **A switchboard polyphase watthour meter is connected through two potential and two current transformers on a 2300-v. three-phase circuit. If the potential**

transformer and current transformer connected to one meter element are removed from the circuit, what percentage of the load would the other meter element register?

*(6.1-8/60) *Answer:* When a polyphase watthour meter is correctly calibrated and connected to a balanced three-phase circuit operating at unity power factor, each element will register 50% of the power transmitted. If the power factor is less than unity, or the load is unbalanced, then one element will record more than 50% and the other will record less, but the sum of the two in all cases will equal 100%. From the foregoing it is evident that if one meter element is disconnected and load is balanced at unity power factor, the other element will record 50% of the power transmitted. But under any other condition the registration of one element will depend upon the circuit conditions.

*(7–8/60) *Question* (**Proportion of Air for Explosive Oil Vapor**): **Is it true that an oil vapor will not be explosive unless it is mixed with an exact amount of air?**

*(7.1–8/60) *Answer:* If a volatile oil is mixed with air, it will not explode if the proportion of the volatile be very small nor will explosion occur if the proportion of oil is large. The explosion range with gasoline is from 2 to 4% of fuel vapor to 100% of air. However, explosions frequently occur with exceedingly rich mixtures. This is because outer edges are of the right proportion, and on igniting diffuse the remainder through the air so that the entire oil charge will explode.

*(8–8/60) *Question* (**Sparking with Too Strong Interpoles**): **What would be the effect of too many turns on the interpoles of a direct-current machine?**

*(8.1–8/60) *Answer:* The object of the interpole is to produce a magnetic field which causes the current in the coil under commutation to reverse and build up in the opposite direction. If the field is too weak, the reversal will occur too late and there will be a sparking; if it is too strong, the reversal will come too early, the current will build up to too high a value, and will have to be suddenly reduced as the commutator bar passes out from under the brush, and there will also be sparking.

*(9–8/60) *Question* (**Parallel Operation of Alternators**): **When two alternators are operating in parallel, why is it impossible to regulate the load on each machine by varying field excitation, as in d.c. machines?**

*(9.1–8/60) *Answer:* The only way to control the load distribution between two alternators operating in parallel, is to adjust the governor as if to vary the speed of the prime mover; for any attempt to raise the voltage on one machine by increasing its excitation will simply set up a circulating wattless current between the two machines, which will weaken the field in the overexcited machine and strengthen it in the other, resulting in a slight increase in the line voltage, but practically no change in the load distribution.

(38) *Question:* **We hear and read a lot about computers these days. Please tell us whether or not it reaches sense for a large mill to have one. What kind of problems would we use it for and what about the economics?**

(38.1) *Answer:* Any mill operation seriously contemplating acquisition of a high-speed digital computer is well advised to conduct a comprehensive feasibility study involving people from the technical department, from quality control, from plant engineering and from production services, as well as individuals connected with the controller's office and other of the "business" functions. With the advent of the smaller, so-called desk-size computers, it is actually no longer necessary for technical and engineering departments to share time on a large and expensive computer with the business services. Quite often economies in the correlation of research and development results and in the maintenance of better quality control records will quite readily take care of the $1200 to $1500 a month rent of devices such as the Bendix G15, the IBM 1620, or the Royal-McBee LGP 30. Initially, the greatest uses a mill would probably give a scientific computer would be in better and more sophisticated statistical analysis of quality control data and of research and development data. There also would be quite extensive use in production services particularly in mathematical assistance to inventory control and to production scheduling. Finally, there would be a number of pesky little problems in the engineering department for which a great saving in design engineers' time would be provided.

As a rough rule of thumb, if a company has two or more of the following types or classes of individuals in its employ, a computer feasibility study is indicated.

A. One full time professional statistician.
B. One full time engineer engaged in process dynamics work.
C. Ten engineers involved in plant design work.
D. Ten chemists or engineers in research and development.
E. One full time professional in operational analysis.

(46) *Question:* **Excitation for synchronous jordan and refiner motors in our mill is distributed from a single 125-v. distribution bus. The main bus in our switchboard is the standard positive, negative, and equalizing and all bus bars are of the same cross section. Two 60-kw. compound-wound interpole generators are arranged for parallel operation and are probably connected through two 3-pole switches to the switchboard. Field rheostats have been provided for each machine. The generators are almost flat compounded, i.e., there is only about 2 v. rise from no load to full load. We have never been able to satisfactorily parallel these generators. No matter how carefully we balance the voltages when a second generator is connected, one or the other of the generators will motor and the other will take all of the load. Our load has grown so that it will overload one generator. How can we parallel these generators?**

(46.2) *Answer:* "If the 125 volt bus can be split allowing each section a load that a 60 kw. generator can carry, operate without the hazard of paralleling."

(46.3) "Assuming generators compounded approximately the same add in series with each generator between series field and pole of negative blade of three pole switch a resistor approximately 0.01 ohm with continuous rating about 750 amp or 150 percent generator rating. This will give about 5 volts drop for the equalizer to become more effective and also tend to droop the generator characteristic. The general rule is to have the resistance of equalizer connection from one generator to the other 20 percent or less the resistance from either series field path from equalizer connection to the negative bus.

"Learn to bring the incoming generator into parallel at a certain volts low otherwise the shunting action of the equalizer will cause incoming generator to grab load even if generator volts were equal prior to closing three pole switch."

Digester Design

Minimum Required Wall Thickness—Exclusive of Corrosion Allowance

TAPPI Data Sheet No. 205

(THIS DATA SHEET UNDER THE JURISDICTION OF THE CORROSION COMMITTEE)

TAPPI Monograph No. 12, Inspection of Digesters, Appendix "C"—Calculation of Allowable Pressures, pp. 135–140, Tables IV–IX

Table I. Vessels Built to 1952 U.P.V. Code 55,000-Lb. Stock—Maximum Stress = 13,750

ID digester, in., D	*Pressures, p.s.i.g. (Joint efficiency, E = 80%)*				
	100	*125*	*150*	*175*	*200*
	t =	*t =*	*t =*	*t =*	*t =*
	0.0091408R	*0.011441R*	*0.013748R*	*0.016062R*	*0.018382R*
72	0.329	0.412	0.495	0.578	0.661
78	0.356	0.446	0.536	0.626	0.716
84	0.384	0.481	0.577	0.674	0.772
90	0.411	0.515	0.619	0.723	0.827
96	0.439	0.549	0.660	0.771	0.882
102	0.466	0.583	0.701	0.819	0.937
108	0.494	0.617	0.743	0.867	0.992
114	0.521	0.652	0.774	0.915	1.046
120	0.548	0.686	0.825	0.965	1.102
126	0.575	0.721	0.866	1.011	1.157
132	0.603	0.755	0.907	1.06	1.212
138	0.630	0.790	0.949	1.108	1.267
144	0.657	0.823	0.990	1.155	1.322

ID digester, in., D	*Pressures, p.s.i.g. (Joint efficiency, E = 85%)*				
	100	*125*	*150*	*175*	*200*
	t =	*t =*	*t =*	*t =*	*t =*
	0.0086R	*0.01076R*	*0.01293R*	*0.01511R*	*0.017289R*
72	0.31	0.3875	0.465	0.544	0.621
78	0.336	0.420	0.505	0.589	0.673
84	0.361	0.452	0.543	0.635	0.725
90	0.387	0.485	0.581	0.680	0.777
96	0.4125	0.516	0.621	0.725	0.829
102	0.439	0.549	0.660	0.770	0.880
108	0.465	0.581	0.698	0.816	0.933
114	0.490	0.614	0.737	0.860	0.984
120	0.516	0.645	0.776	0.907	1.037
126	0.541	0.678	0.815	0.952	1.088
132	0.568	0.710	0.854	0.997	1.140
138	0.593	0.742	0.892	1.042	1.191
144	0.620	0.775	0.931	1.089	1.243

ID digester, in., D	*Pressures, p.s.i.g. (Joint efficiency, E = 90%)*				
	100	*125*	*150*	*175*	*200*
	t =	*t =*	*t =*	*t =*	*t =*
	0.0081201R	*0.010162R*	*0.01221R*	*0.01426R*	*0.016319R*
72	0.292	0.366	0.440	0.514	0.588
78	0.317	0.396	0.476	0.556	0.637
84	0.341	0.426	0.513	0.598	0.685
90	0.366	0.456	0.550	0.641	0.735
96	0.390	0.487	0.586	0.683	0.784
102	0.414	0.518	0.623	0.727	0.833
108	0.439	0.549	0.659	0.770	0.882
114	0.463	0.579	0.696	0.813	0.931
120	0.487	0.609	0.733	0.855	0.970
126	0.512	0.640	0.769	0.897	1.029
132	0.536	0.670	0.806	0.941	1.077
138	0.560	0.700	0.843	0.984	1.127
144	0.585	0.731	0.879	1.026	1.175

ID digester, in., D	*Pressures, p.s.i.g. (Joint efficiency, E = 95%)*				
	100	*125*	*150*	*175*	*200*
	t =	*t =*	*t =*	*t =*	*t =*
	0.0076908R	*0.009624R*	*0.0115629R*	*0.013528R*	*0.015452R*
72	0.275	0.347	0.416	0.488	0.556
78	0.300	0.376	0.451	0.528	0.603
84	0.323	0.404	0.485	0.569	0.649
90	0.346	0.433	0.520	0.609	0.695
96	0.368	0.462	0.555	0.650	0.741
102	0.392	0.491	0.590	0.691	0.788
108	0.415	0.520	0.624	0.731	0.835
114	0.438	0.549	0.659	0.772	0.881
120	0.451	0.577	0.694	0.813	0.927
126	0.485	0.606	0.729	0.853	0.974
132	0.507	0.635	0.763	0.894	1.020
138	0.530	0.665	0.798	0.935	1.065
144	0.553	0.693	0.833	0.975	1.112

Table II. Vessels Built to 1952 U.P.V. Code 70,000 Lb. Stock—Maximum Stress = 17,500

ID digester, in., D	*Pressures, p.s.i.g. (Joint efficiency, E = 80%)*				
	100	*125*	*150*	*175*	*200*
	t =	*t =*	*t =*	*t =*	*t =*
	0.007173R	*0.0089759R*	*0.0107836R*	*0.012594R*	*0.014409R*
72	0.258	0.323	0.388	0.453	0.519
78	0.280	0.350	0.421	0.491	0.562
84	0.302	0.377	0.453	0.529	0.605
90	0.323	0.404	0.485	0.566	0.649
96	0.344	0.430	0.517	0.605	0.692
102	0.366	0.458	0.550	0.642	0.735
108	0.387	0.485	0.583	0.680	0.778
114	0.408	0.511	0.615	0.717	0.822
120	0.431	0.539	0.647	0.755	0.865
126	0.452	0.565	0.680	0.794	0.908
132	0.473	0.592	0.712	0.831	0.951
138	0.495	0.619	0.745	0.869	0.995
144	0.516	0.646	0.776	0.907	1.037

Table II. Vessels Built to 1952 U.P.V. Code 70,000 Lb. Stock—Maximum Stress = 17,500

ID digester, in., D	Pressures, p.s.i.g. (Joint efficiency, E = 85%)				
	100 t = 0.00675R	125 t = 0.008459R	150 t = 0.010145R	175 t = 0.011509R	200 t = 0.01355R
72	0.243	0.305	0.365	0.414	0.488
78	0.263	0.330	0.396	0.449	0.529
84	0.284	0.355	0.426	0.483	0.569
90	0.304	0.381	0.457	0.518	0.610
96	0.324	0.406	0.487	0.552	0.651
102	0.345	0.432	0.517	0.587	0.691
108	0.365	0.457	0.548	0.621	0.732
114	0.385	0.482	0.578	0.656	0.773
120	0.405	0.508	0.608	0.690	0.813
126	0.426	0.533	0.639	0.725	0.854
132	0.446	0.559	0.669	0.759	0.895
138	0.466	0.584	0.670	0.794	0.936
144	0.487	0.609	0.730	0.828	0.976

ID digester, in., D	Pressures, p.s.i.g. (Joint efficiency, E = 90%)				
	100 t = 0.006373R	125 t = 0.0079745R	150 t = 0.0095785R	175 t = 0.011185R	200 t = 0.012796R
72	0.229	0.287	0.345	0.402	0.460
78	0.249	0.311	0.374	0.436	0.498
84	0.268	0.335	0.402	0.469	0.536
90	0.287	0.359	0.431	0.503	0.575
96	0.306	0.383	0.460	0.536	0.614
102	0.327	0.407	0.489	0.570	0.652
108	0.344	0.430	0.517	0.604	0.690
114	0.363	0.455	0.546	0.637	0.729
120	0.382	0.479	0.575	0.671	0.767
126	0.402	0.502	0.604	0.705	0.806
132	0.421	0.526	0.632	0.738	0.845
138	0.440	0.550	0.661	0.771	0.882
144	0.459	0.574	0.690	0.805	0.921

ID digester, in., D	Pressures, p.s.i.g. (Joint efficiency, E = 90%)				
	100 t = 0.0060368R	125 t = 0.007552R	150 t = 0.0090716R	175 t = 0.010593R	200 t = 0.012117R
72	0.218	0.272	0.326	0.382	0.437
78	0.236	0.295	0.354	0.413	0.473
84	0.254	0.318	0.381	0.445	0.519
90	0.272	0.340	0.408	0.476	0.545
96	0.290	0.363	0.435	0.508	0.581
102	0.308	0.386	0.462	0.540	0.616
108	0.326	0.408	0.489	0.572	0.655
114	0.344	0.431	0.517	0.604	0.691
120	0.363	0.453	0.544	0.635	0.727
126	0.381	0.476	0.571	0.667	0.764
132	0.399	0.498	0.598	0.699	0.800
138	0.417	0.521	0.625	0.730	0.836
144	0.435	0.545	0.653	0.763	0.873

Table III. Vessels Built to 1952 Code 75,000 Lb. Stock—Maximum Stress = 18,750

ID digester, in., D	Pressures, p.s.i.g. (Joint efficiency, E = 80%)				
	100 t = 0.006693R	125 t = 0.008375R	150 t = 0.01006R	175 t = 0.011748R	200 t = 0.01344R
72	0.241	0.302	0.362	0.423	0.484
78	0.261	0.327	0.392	0.458	0.524
84	0.281	0.352	0.423	0.493	0.564
90	0.301	0.377	0.453	0.529	0.605
96	0.321	0.402	0.483	0.564	0.645
102	0.341	0.427	0.513	0.599	0.685
108	0.361	0.452	0.543	0.634	0.726
114	0.382	0.477	0.573	0.669	0.766
120	0.402	0.502	0.604	0.705	0.806
126	0.422	0.527	0.634	0.740	0.847
132	0.442	0.553	0.664	0.775	0.887
138	0.462	0.578	0.694	0.810	0.927
114	0.482	0.603	0.724	0.845	0.967

ID digester, in., D	Pressures, p.s.i.g. (Joint efficiency, E = 85%)				
	100 t = 0.006298R	125 t = 0.00788R	150 t = 0.009465R	175 t = 0.01105R	200 t = 0.01264D
72	0.227	0.284	0.341	0.398	0.455
78	0.245	0.307	0.369	0.431	0.493
84	0.264	0.331	0.398	0.464	0.531
90	0.283	0.355	0.426	0.497	0.569
96	0.302	0.378	0.454	0.531	0.607
102	0.321	0.402	0.483	0.564	0.645
108	0.340	0.425	0.511	0.597	0.682
114	0.359	0.449	0.540	0.630	0.720
120	0.378	0.473	0.568	0.663	0.758
126	0.397	0.496	0.596	0.697	0.796
132	0.415	0.520	0.625	0.730	0.834
138	0.434	0.543	0.653	0.763	0.872
144	0.453	0.567	0.682	0.796	0.910

ID digester, in., D	Pressures, p.s.i.g. (Joint efficiency, E = 90%)				
	100 t = 0.005947R	125 t = 0.00744R	150 t = 0.0089365R	175 t = 0.010435R	200 t = 0.011937R
72	0.214	0.268	0.322	0.376	0.430
78	0.232	0.290	0.349	0.407	0.466
84	0.250	0.312	0.375	0.438	0.501
90	0.268	0.335	0.402	0.470	0.537
96	0.285	0.357	0.429	0.501	0.573
102	0.303	0.379	0.456	0.532	0.609
108	0.321	0.402	0.483	0.564	0.645
114	0.339	0.424	0.509	0.595	0.680
120	0.357	0.446	0.536	0.626	0.716
126	0.374	0.469	0.563	0.657	0.752
132	0.392	0.491	0.590	0.689	0.788
138	0.410	0.513	0.617	0.720	0.824
144	0.428	0.535	0.643	0.751	0.859

ID digester, in., D	Pressures, p.s.i.g. (Joint efficiency, E = 95%)				
	100 t = 0.005627R	125 t = 0.007047R	150 t = 0.0084638R	175 t = 0.009877R	200 t = 0.011304R
72	0.203	0.254	0.305	0.356	0.407
78	0.220	0.275	0.330	0.385	0.441
84	0.236	0.296	0.356	0.415	0.475
90	0.253	0.317	0.381	0.444	0.509
96	0.270	0.338	0.406	0.474	0.543
102	0.287	0.359	0.432	0.504	0.576
108	0.304	0.380	0.457	0.533	0.610
114	0.321	0.401	0.483	0.563	0.644
120	0.338	0.423	0.508	0.592	0.678
126	0.355	0.444	0.533	0.622	0.712
132	0.372	0.465	0.559	0.652	0.746
138	0.389	0.486	0.584	0.681	0.780
144	0.405	0.507	0.610	0.711	0.814

Fifteenth Engineering Conference of the Technical Association of the Pulp and Paper Industry

Robert Meyer Hotel
Jacksonville, Fla.
Oct. 24-28, 1960

Approximate Requirements for Electric Power in Pulp Bleaching

TAPPI Data Sheet No. 202

THIS DATA SHEET UNDER THE JURISDICTION OF THE ELECTRICAL ENGINEERING COMMITTEE

The following data are provided for general estimating purposes in the preliminary planning of bleach plant power requirements. Specific installations may differ appreciably in precise requirements but will normally not greatly exceed the data given.

The data do not include the power required for pumping stock to or from the bleach plant nor the power required for the water used in the bleach plant. A rough estimating figure for the pumping of stock is 5 kw.-hr. per ton.

A rough estimating figure for water (based on 40,000 gal. per ton at a total head of 200 ft.) is 32 kw.-hr. per ton. Approximately the same water is required for a three-stage bleach as a five-stage bleach.

Approximate Electric Power Requirement—Pulp Bleaching

Steps	*150 tons per day*		*300 tons per day*	
	Motor, h.p.	*Kw-hr. per ton*	*Motor, h.p.*	*Kw.-hr. per ton*
1. Liquor making, Cl_2, hypo, caustic	60	5.2	109	5.2
2. Chlorination, stage 1	233	20.2	240	11.4
3. Caustic extraction, stage 2	240	21.0	450	21.0
4. Hypo, stage 3	270	23.5	425	20.5
Three-stage bleach such as used on hardwood or semibleach operations				
Total—steps 1 to 4	803	69.9	1224	58.1
5. Liquor making chlorine dioxide	40	3.5	50	2.3
6. Chlorine dioxide, stage 4	385	33.5	485	23.0
7. Auxiliaries	85	7.1	130	6.1
Total—steps 1 to 7	1313	114.0	1889	89.5
8. For fifth stage, peroxide, add	300	26.0	380	18.0
Total—steps 1 to 8	1613	140.0	2269	107.5

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RC-283. Quality of Release Coatings

The following test is designed to compare two main properties of release coatings: (1) Ease of release (as "release force"). (2) The effect which the coating has upon the adhesive properties of a pressure-sensitive tape which has contacted the surface ("subsequent adhesion").

Apparatus

1. The Keil Tester,* Model 1, or similar machine.
2. A roll of pressure-sensitive tape, one inch wide. Johnson and Johnson Red Cross Waterproof Adhesive tape is satisfactory.
3. A stainless steel test panel, 3 by 6 by $^1/_{16}$ in., which will serve as a control surface for the subsequent adhesion portion of the test. The panel is to be ground with a 280 grit belt in a lengthwise direction.**
4. A rubber-faced tape roller,* having a weight of $4^1/_2 \pm 0.1$ lb. The approximate dimensions are: diameter, $3^1/_2$ in.; width, $2^1/_4$ in.; thickness of rubber facing, $^1/_4$ in.; hardness of rubber facing, 75 ± 5 durometer (Shore A scale).
5. Two smooth metal pressure plates, and weights sufficient to apply a uniform pressure of $^1/_4$ p.s.i. on the test tape. Aluminum plates, $^1/_{16}$ in. thick, can be used.† A plate 6 by 4 in. will have sufficient area to accommodate three test specimens at one time. Tested in this way, the three specimens will require four 18 oz. weights to provide the necessary pressure.
6. An air-circulating oven capable of maintaining a temperature of approximately 70°C. (158°F.) for 20 hr.

Discussion

"Release force" is defined as the pull required to separate a standard adhesive tape from a given sample of coated paper, expressed in grams per inch width.

"Subsequent adhesion" is defined as the force required to pull a standard test tape from a stainless steel panel, after the tape has been in contact with a release-coated paper. It, too, is expressed in grams per inch width. Results must be compared with a control tape which has not been in contact with the coated paper. This test will detect transfer of the release coating to the tape. It also shows whether or not a given release material is suitable as an interleaving material for pressure sensitive tapes.

The results of this test method can be correlated with the results of field tests to establish standards of quality for coated release papers.

Both release force and subsequent adhesion can be measured with the Keil tester, Fig. 1. This machine is designed to strip tapes from test surfaces at a constant-speed pull of 12 in. per min. The pull is measured on a dial spring scale (graduated in grams) as the tape is stripped. Test specimens are held in suitably designed clamps so that, as a pull is applied, the stripped tape and the test surface form an angle of 180° to one another.

The following ideas should be considered when interpreting test results.

Low release force values, coupled with high subsequent adhesion values, mean that the release properties of the coating are good. High release values indicate that the release coating is relatively ineffective—due to an inadequate coating or a low quality coating material. Uneven release values may indicate that the coating is not evenly applied.

Low subsequent adhesion values are usually undesirable. When combined with low release values, low subsequent adhesion can be attributed to any of several factors: transfer of coating to the tape surface, a rough substrate, or deterioration of the adhesive tape during the 158°F. conditioning. The latter factor may be due to evaporation of solvents or plasticizers from the adhesive. A rough substrate produces an irregular surface on the adhesive, reducing its contact area, and thus lowering subsequent adhesion. Low subse-

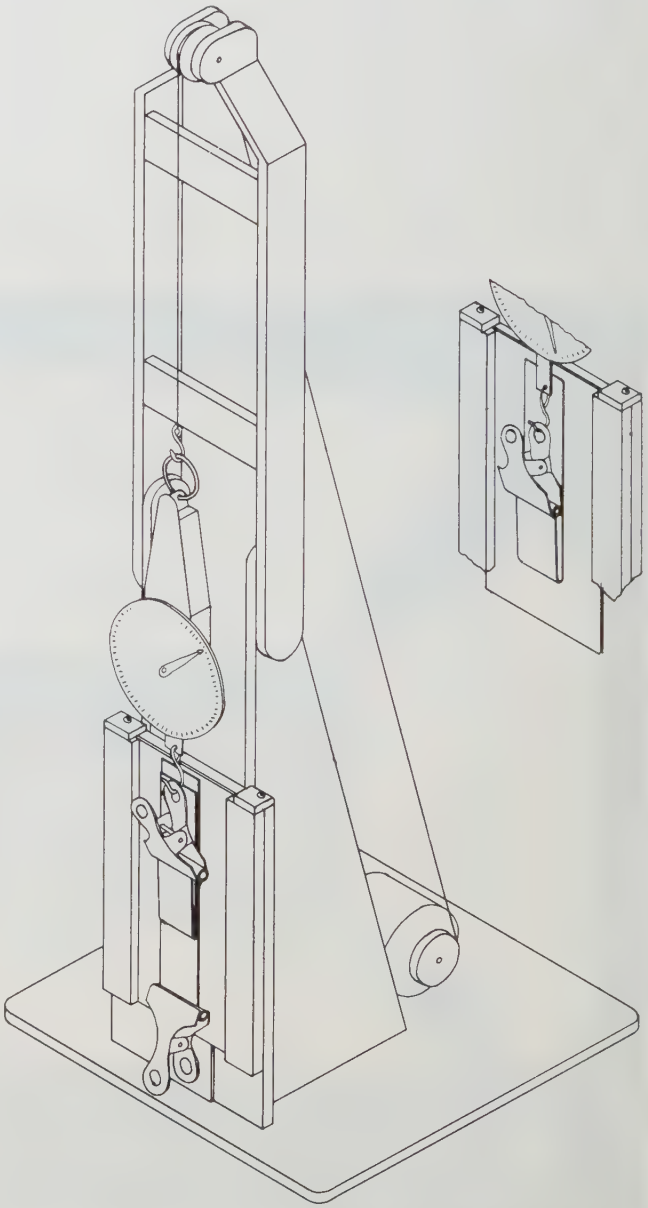

Fig. 1

* The Keil Tester is available from Dow Corning Corp., Midland, Mich.
** These items are regularly supplied with the Keil Tester.
† A roller of this type can be obtained from the U. S. Testing Co., Hoboken, N. J.

quent adhesion values may also be produced when release force values are high. The reason, as shown by microscopic examination, is that poor release pulls the adhesive into tiny peaks, leaving less contact area for adhesion.

Operation of Test

Clean the stainless steel test panel. Pour toluene (reagent grade) on a lint-free tissue and rub the panel in a lengthwise direction to remove all foreign matter. Allow the panel to air-dry. Handle the panel by the edges so that fingermarks will not reduce the adhesion of the tape.

Next, strip the first three layers of tape from the roll, and discard. Cut a minimum of six 6-in. strips of tape from the roll. Apply every other strip, adhesive side down, to a sample of the release-coated paper. Place these tape-on-paper specimens between the metal pressure plates, and add enough weights to produce a uniform pressure of $^1/_4$ p.s.i. of tape. Place the weighted samples in the oven at 70°C. (158°F.) for 20 hr.

After the tape-on-paper laminates have been placed in the oven, apply one of the three remaining strips of tape to the stainless steel test panel with two passes of the tape roller. Do not use extra pressure, but only the free weight of the roller. Lock the panel into the holder at the base of the Keil tester, pull up the bottom end of the test tape, and fasten this end to the scale. Start the machine, strip the tape from the metal panel, and record the dial readings each inch, as the tape is pulled, as "adhesion of control tapes" in grams per inch width.

When the tape-on-paper laminates have completed the specified 20-hr. aging in the oven, take them out and allow them to cool to room temperature. Peel back one end of the tape from the paper for about an inch, and insert the paper in the fixed (bottom) clamp and the tape in the top clamp of the Keil tester. The paper must be cut into strips to fit into the test clamp; this may be done before or after the oven-aging period.

Start the tester, and jot down the dial reading at 1-in. intervals as the tape is stripped from the paper. Repeat the procedure for the other two tapes. Record all readings as "release force" in grams per inch width.

Immediately after each tape is stripped from the paper, apply it to a stainless steel panel as in the control test, making sure that the panel is thoroughly cleaned with toluene between each operation. Next, insert the stainless steel panel in the Keil tester and pull each tape. Record the dial readings at 1-in. intervals as "subsequent adhesion."

The precision of this test is dependent upon the uniformity of the adhesive tape and the uniformity of the release coatings. The range of determinations on the control tapes gives an idea of the precision in each case.

Results

Each recorded portion of the test—"adhesion of control tape," "a release force," and "subsequent adhesion"—provides 15 readings for each test series. These 15 values should be averaged to yield final rules for each portion of the test. It is on these average values that a judgment of the quality of the release coating may be based.

The following report form may be used:

Identification of paper:
Identification of test tape:

	Average of 15 Readings	*Range (High value minus low value)*
Adhesion of control tape		
Release force		
Subsequent adhesion		

Submitted by
L. H. Reinke
Dow Corning Corp.
Midland, Mich.

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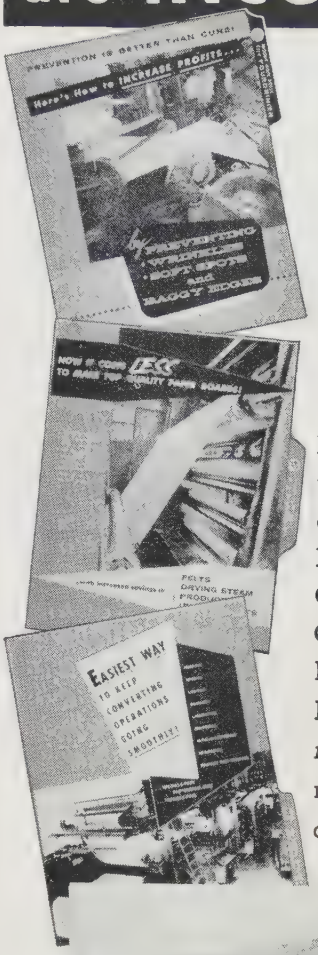

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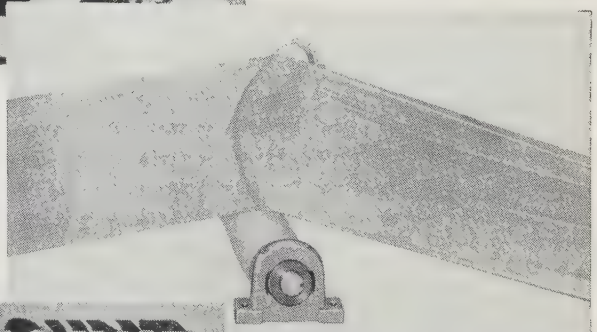

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LOCAL SECTION ACTIVITIES

Meeting Calendar

September, 1960

9 Central District, Empire State Section, University Club, Syracuse, N. Y. Speaker, Dr. L. G. Stockman, Swedish Cellulose Industry Central Laboratory.
12 Eastern District, New England Section, Armand's Beacon Terrace, Framingham, Mass.
13 Metropolitan District, Empire State Section, 465 Lexington Ave., New York, N. Y.
Ohio Section, Middletown, Ohio. Speaker, Dr. L. G. Stockman, Swedish Cellulose Industry Central Laboratory.
14 Delaware Valley Section, Visit to Hamilton Paper Co., Miquon, Pa. Dinner at Anchorage Inn. Speaker, Dr. L. G. Stockman, Swedish Cellulose Industry Central Laboratory.
15 St. Louis Section, Le Chateau Restaurant, 10405 Clayton Rd., St. Louis County, Mo., "Paper Coatings Based on Cellulose Derivatives and Parlon Film Formers on Paper."
16–17 Southeastern Section, Roosevelt Hotel, Jacksonville, Fla. Dr. L. G. Stockman, Swedish Cellulose Industry Central Laboratory, speaker. Plant tour at Container Corp. of America, Fernandina.
19–20 Pacific Section, Seattle, Wash., Seminar. Dinner meeting also on the 19th.
22–23 Pacific Section, Portland, Ore., Seminar. Dinner meeting also on the 22nd.

October, 1960

7–8 New England Section, joint meeting with Connecticut Valley PIMA, Schine Inn, Chicopee, Mass.
11 Metropolitan District, Empire State Section, 465 Lexington Ave., New York, N. Y.
27 Delaware Valley Section, Engineers Club, Philadelphia, Pa. Panel on "Stock Cleaning."

November, 1960

9 Metropolitan District, Empire State Section, 465 Lexington Ave., New York, N. Y.
14 Eastern District, New England Section, Armand's Beacon Terrace, Framingham, Mass.
16 Pacific Section, Salem, Ore., "Modernization."
17 St. Louis Section, Le Chateau Restaurant, 10405 Clayton Rd., St. Louis County, Mo., "Recent Advances in the Packaging Field," by C. P. Olstad, Crown Zellerbach Corp.
18–19 Southeastern Section, Dinkler Plaza Hotel, Atlanta, Ga.

December, 1960

5 New England Section, Storrowton Tavern, West Springfield, Mass.
9 Delaware Valley Section, Engineers Club, Philadelphia, Pa., "Functional Coatings."
13 Metropolitan District, Empire State Section, 465 Lexington Ave., New York, N. Y.

January, 1961

9 Eastern District, New England Section, Armand's Beacon Terrace, Framingham, Mass.
10 Metropolitan District, Empire State Section, 465 Lexington Ave., New York, N. Y. "State of the Industry," W. R. Adams, St. Regis Paper Co., New York, N. Y.
17 Pacific Section, Tacoma, Wash., "Process and Quality Control Techniques."
20–21 Southeastern Section, Francis Marion Hotel, Charleston, S. C.
26 Delaware Valley Section, Engineers Club, Philadelphia, Pa., "Packaging."

March, 1961

13 Eastern District, New England Section, Armand's Beacon Terrace, Framingham, Mass.
14 Metropolitan District, Empire State Section, 465 Lexington Ave., New York, N. Y.
21 Pacific Section, Longview, Wash., Shibley Award Meeting.
24–25 Southeastern Section, Bon Air Hotel, Augusta, Ga. Tour of Continental Can Co.

April, 1961

10 New England Section, Storrowton Tavern, West Springfield, Mass., Management Night.
11 Metropolitan District, Empire State Section, 465 Lexington Ave., New York, N. Y.

May, 1961

4–6 Pacific Section, Harrison Hot Springs, Tri-Way Convention.
19 Metropolitan District, Empire State Section, Ladies Night.
19–20 Southeastern Section, General Oglethorpe Hotel, Savannah, Ga.

June, 1961

8–10 Empire State Section, Whiteface Inn, Whiteface, N. Y.
9–10 Joint Meeting, New England Section and Maine–New Hampshire Section, Wentworth-by-the-Sea, N. H.

June, 1962

1–2 New England Section, Chatham Bars Inn, Chatham, Mass.
7–9 Empire State Section, Whiteface Inn, Whiteface, N. Y.

June, 1963

6–8 Empire State Section, Whiteface Inn, Whiteface, N. Y.

June, 1964

11–13 Empire State Section, Whiteface Inn, Whiteface, N. Y.

10–12 Empire State Section, Whiteface Inn, Whiteface, N. Y.

Ohio (Indiana District)

On April 19, the Indiana District of the Ohio Section were hosts to 25 high school science teachers and educators. Beginning at 2 o'clock in the afternoon, members and their guests were conducted on a tour of the Paper Package Co. plant in Indianapolis. This is one of the outstanding folding carton, package manufacturing, and converting facilities in the Middlewest. The tour included all phases of the preparation of boxboard and covering paper from the conversion of the roll stock by lining, printing, die cutting, glueing, and packing of the finished cartons. After the mill tour the members of the Indiana District and their guests gathered at the Marott Hotel for a social hour and a chance to get acquainted with the science teachers. A panel discussion titled, "The Job of the Technical Man in the Paper Industry," was conducted by A. B. Lincoln of the Inland Container Corp. The panel consisted of the following members:

M. L. Johnson—Container Corp. of America
John Sullivan—Monsanto Chemical Co.
Frank Sulc—R. R. Donnelley & Sons Co.
James Casey—Union Starch Co.

Each of the panelists told of the various aspects of his job in the paper industry.

The Education Committee, under the direction of Myron Clark of Inland Container Corp. and W. Z. Walters of Beveridge Paper Co. were responsible for bringing the teachers together as guests of the Indiana District. Mr. Clark made an introduction to the guests and members outlining the work of the TAPPI organization, the paper industry, its place in our economy, and the tremendous opportunity available to technical graduates of colleges and universities for a lifelong field of work in the pulp and paper industry.

Part of the group of 24 high school science teachers, guests of Indiana District meeting, April 19, 1960. Those attending were: Mrs. Henrietta Parker, Miss Marie VanHorn, Bruce Skiles, Frederick Mason, and Mrs. Jean Prettyman, Shortridge High School; Robert Prettyman, North Central High School; Mr. Smith, Mr. Kassig, Mr. Seldon, and Mr. Lloyd, Broadripple High School; Wayne Kincaid, Richard Cummins, Wayne Dunbar, and Raymond Ashley, Emmerich Manual Training High School; Mrs. Phyllis Loffland, Charles Hawthorne, Herschel Ross, and Frank Munschamer, George Washington High School; Floyd Jeffries, Richard Hammond, Richard Dowell, and Virgil Heniser, Howe High School; Brother Albert, Cathedral High School; and Myron L. Clark, principal of Hartford City High School of Indiana and also a chemistry teacher at Hartford City High School

"The Job of the Technical Man in the Paper Industry," discussed by the above panel at Indiana District Meeting, April 19, 1960. Left to right: M. L. Johnson, Frank Sulc, John S. Sullivan, W. B. Lincoln, Jr., and James Casey

Outside the meeting room the committee had set up a display showing hundreds of items used in daily life that are made from paper indicating the important role the industry plays in the economy and the life of our country. Copies of the TAPPI publication, "What You Should Know About Career Opportunities Offered by the Pulp and Paper Industry," were distributed to the guests. Virgil E. Perry, chairman of the Ohio Section of TAPPI was a guest for this meeting.

Welcome and Introductory Remarks

M. J. Clark

To OUR teacher-guests, since the Education Committee is your official host, it is my pleasure to welcome you to the Indiana District of TAPPI. We hope that you saw many things of interest during the plant tour at Paper Package Co.—whom we thank for their part in our program. We hope that during the course of the afternoon, and here at the dinner, you have been made to feel a part of the group.

WHAT TAPPI IS

The Technical Association of the Pulp and Paper Industry is a national technical society organized for the search and dissemination of knowledge relating to pulp and paper in all of its forms, including paperboard, structural boards, and converted paper products. The Association was founded in 1915. It is the largest organization in the world (over 9000 members) of top executives, managers, superintendents, engineers, and technical men serving the paper and allied industries.

Most of the members have degrees from colleges or institutes of technology and/or experience in the pulp and paper industry. Their motive in joining TAPPI is a desire to keep abreast of technological developments in their field through the medium of TAPPI publications, to participate in technical committee work, and to attend regional and national TAPPI meetings.

PURPOSE OF THE EDUCATION COMMITTEE'S INVITATION

The members of the Education Committee had the following thoughts in mind in inviting you.

Few students ever hear of our industry or learn of its many and varied career possibilities. Yet we are one of the largest industries and very important in the economy of the country.

A Purdue professor—one of our members—berated us for

our lackadaisical methods of getting engineers or technicians and lack of promotion of an industry of our prominence.

We felt it would be helpful to you teachers and in turn helpful to students and possibly eventually to industry to invite you to listen in on our program for tonight.

Some of you asked why we invited you specifically. If you, as teachers closest to future scientists or technicians, will mention just once during the year to your students that paper is a large and important segment of industry, and that they might give some consideration to this field in their college studies or as a vocation, we will feel completely repaid. After this brief commercial, I would like to tell you a little about what "paper" is.

WHAT IS PAPER, PAPER PRODUCTS AND THEIR PLACE IN OUR ECONOMY?

(Samples of unusual examples of paper products, such as piece of rug with kraft yarn backing, open-mesh bag, masonite hardboard, Formica, wall board, etc. were shown).

These are some of the products of the industry we are talking about:

Notice the centerpiece decoration on the table depicting the pine tree—source of our raw material—and showing in miniature other uses of paper products. Also the paper table cloths, napkins, cup, and plates. (Notice how much quieter it was at dinner without dishes rattling?—These were courtesy of Paper Arts Co.)

There are more ways of introducing the subject of paper than there are people here. The grocery bags filled with paper products, which you see decorating the sides of the room, suggest the following. There are 12,000,000 paper bags used by one supermarket chain each year. This consists of nine sizes, the small no. 3, no. 5, etc., up to the "bundle bag" which holds what is known as $^1/_6$ barrel or about 35 lb. If you require anything larger, you have become confused and picked up the girl at the cash resister in your haste.

It's been estimated that we wad up about 18 billion dollars worth of paper packaging products a year—sacking, wrappings, boxes, cartons, liners, and what have you.

To illustrate the place of paperboard containers in the packaging industry, following is their use in relation to other containers with which you are familiar.

Paperboard containers—31% (of $ sales, approximate)
Wrapping papers—16%
Metal cans—14%
Paper and textile bags—10%
Glass containers—7%
Flexible films and foils and plastics—6%
Wood containers—5%
Closures, labels, steel drums, etc., 11%

From the writing of the birth certificate to death notice, paper is the one commodity that is used in all facets of our lives—food, shelter, livelihood, education, communications, and entertainment.

Someone stated it would be a good idea if the paper used in connection with collecting taxes would disintegrate—but if that happened, we would also lose all of our paper money, checks, and records.

In terms of sales, the paper industry is the fifth largest manufacturing industry. The position of the paper industry is exceeded only by automobiles, meat packing, steel, and petroleum refining. It has more than 6 billion dollars in assets and 548,000 employees earning $2^1/_4$ billion dollars a year. About half of these are in the primary paper, paperboard, and pulp mills and half in converting operations and their dependents.

Directly dependent on the paper industry are the printing and publishing industries. They give employment to even a greater number of persons, 812,000.

The mills and plants rank with the most progressive, technically advanced plants in their areas. They are financially stable and have good labor relations and face an ever growing consumer demand.

Here are a few production figures. These are in general terms for more interesting presentation and not necessarily exactly up-to-date nor specific.

If the production of paper and board were loaded into freight cars, it would make a train 9000 miles long.

For every car of finished paper or board leaving a mill, four or six cars of raw materials are required. The value of chemicals used by the industry is $250,000,000 annually. For every ton of paper manufactured, the industry uses roughly a quarter of a ton of chemicals. Although fertilizer manufacture leads the field in tonnage consumption, pulp and paper, paint and varnish, and rayon are other major chemical consumers, each consuming approximately 10% of the total production.

There were enough paper napkins made to make a sheet 14.5 million miles long—570 times around the world.

The industry uses about 30 billion kw.-hr. of electricity per year, more than double the amount used by New York City industries, stores, and homes.

Paper ranks first among all industries as a generator of power for its own use, seventh as a purchaser of power from others, and third in its total industrial requirements, exceeded only by the chemical and iron and steel industries.

The industry manufactured 73 billion paper bags (420 per person) 100 billion paper boxes (575 per person) 11 billion milk containers (63 per person) 4 billion greeting cards (23 per person), annually.

The industry consumed approximately 33,000,000 cords of pulpwood. If each stick 4 ft. long of 90 to a cord were laid end to end, the "line" would be 2,300,000 miles long—more than four round trips to the moon.

A modern paper machine is as long as a football field. It will produce a sheet of paper 25 ft. wide at approximately 25 m.p.h.

You have heard of various types of products represented by our local group. There are about 20 different major classifications of paper and paperboard—not to enumerate the many diversified converted products. A discussion of these in themselves could provide a full evening's entertainment.

The members of TAPPI will be glad to answer questions you may get into at any time.

The Job of the Technical Man in the Paper Industry

(Notes in connection with panel discussion of this subject at Indiana District TAPPI meeting April 19, 1960. W. B. Lincoln, Jr., acted as moderator.)

Four panel speakers were introduced, each covering the general area of his experience and work as outlined on the material herewith.

It was pointed out that the panel was to discuss the job of the technical man in the paper industry, specifically, to answer such questions as what kind of an education does he need, what kind of a person and personality does he need to be. Further, what does his job offer in the way of financial remuneration and psychological satisfaction. Does it offer breadth of opportunities, considerable variety, and good working conditions. Does it offer opportunity to the student who is preparing for his life work in the technical field.

After this recitation of experiences and jobs, I think we can safely conclude the following:

1. That a good education is of major importance in making a success in the technical field. This is true whether it be in paper, metals, or missiles.

2. The spread of training and education taken by the members of this panel will show that the exact kind of engineering or technical course or where you take it is probably not all important. Important, however, is the fundamental fact that one has been exposed to a scientific program in a number of different disciplines and has seriously applied himself to the study of them. It is probable that ultimate goals

are attained eventually through an amalgamation of many things such as the personal interest pattern of the individual, opportunities that present themselves, sometimes in the breaks (but I personally believe that you make your own), environment and the ability to not worry about where you are going but to work like "hell" to get there.

The real professional man never stops studying. As an interesting sidelight on the background of your panel speakers, I checked to see how many affiliations with technical societies and associations were represented in the group. It is interesting to note that the membership of the panel carry affiliations with ten scientific or industry groups. These are represented in eighteen separate memberships for an average of three per individual: (see tabulation herewith).

Through membership in these organizations, many personal contacts are made at meetings such as this and there are programs and publications to keep the technical man informed and up-to-date.

The technical man reads extensively in magazines, trade papers, and textbooks because this is a necessary part of his life.

I hope we have given you a picture of the job of the technical man in the paper industry. It has been painted with a broad brush but do not make the common mistake of considering paper simple. It is most complex and much challenging work awaits the man interested in science and technical areas in our field.

The Job of the Technical Man in the Paper Industry

Areas of activity	*Typical functions or departments*	*Job titles—typical*	*Speaker emphasizing area*
Established manufacturing	Supervision or management	Mill Manager officer superintendent	M. L. Johnson
	Product control	Control chemist statistician	
	Quality control	Q. C. manager Q. C. chemist Q. C. physicist	
	Plant engineering	Plant engineer	
	Maintenance	Maintenance engineer Instrument engineer	
Established sales	Sales	Sales manager	John Sullivan
	Marketing	Salesman-technical prod. specifications	
	Customer service	Customer serv. eng. trouble shooter biological control	
Established consumers	Management	Manager	Frank Sulc
	Product control	Superintendent	
	Quality control	Chemist	
	Plant engineering	Q. C. engineer	
	Research	Research engineer	
	Maintenance	Engineer-various	
Projected or future program	Research laboratory	Market analyst	James Casey
	Research management	Research director	
	Development department	Research director	
	Engineering	Research forester Research engineer Research chemist Research physicist Research statistician	

Note: Many opportunities are afforded for specialization in all of the areas listed, such as: Forestry, Pulping, Papermaking, Coating, Coloring, Converting, Laminating, Adhesives, Printing & Inks, Carton & Containers, Testing-Various Areas, etc.

Empire State (Eastern District)

The March 17 meeting of the Eastern District of the Empire State Section of TAPPI was held at the Queensbury Hotel in Glens Falls, N. Y. There were 73 members and guests in attendance.

Chairman Paul Page opened the meeting at 8:00 p.m. with the introduction of James W. Field, local section assistant of TAPPI from New York City.

The treasurer, W. Montgomery, reported a checking balance of $282.12 and a reserve fund of $527.60 for a total of $809.72.

Chairman Page reminded the group that on May 21 Ladies Night will be held at the Top O' the World in Lake George. Gordon Nicolson commented on the Fifth Annual Symposium to take place on April 21.

John Williams our Educational Chairman introduced the first phase of the program by presenting the three winners of the High School Essay Contest and their teachers. The subject of their essays was "The Opportunities I See in the Paper Industry." The teachers and students are as follows:

Mr. Harry Gross—Teacher at Hudson Falls High School
1st prize went to Allen Forrest who presented his essay to members and guests.
2nd prize went to John Huckle.
L. Sparling—Teacher at South Glens Falls High School.
3rd prize went to Steve Ostrander.

The judges for the contest were Earl Johnson, Allan Lowe, and William Lord.

The second phase of the program was the presentation of the Junior Awards. The three guest speakers were introduced by our Junior Awards Chairman Harold Loke.

1st prize "Measurement of Force of Stripping Sheet from Paper Machine Wire," by W. R. Woodard, Research Division, International Paper Co., South Glens Falls, N. Y.
2nd prize "Practical Color Matching Using a Trimbey Metering System," by Patrick J. Doyle, assistant pulp preparation superintendent, Finch Pruyn and Co., Glens Falls, N. Y.
3rd prize "The Training of Present and Future Personnel," by Earl L. Marshall, Beater Room Superintendent, Smealie & Voorhees, Inc., Amsterdam, N. Y.

The judges were Donald Wells, Jr., of APMEW, Robert Blakeslee of Imperial Color Chemical and Paper Co., and Roger J. Trimbey of Trimbey Machine Works.

Phase three of the program was the election of officers for 1960–61. The nominating committee composed of Al Oetken, Chairman, Paul Page, Richard Collins, Robert

Left to right: Paul Page, chairman, Eastern District, Imperial Color Chemical & Paper Corp.; Wm. R. Woodard, I. P. Research; Earl Marshall, Smeallie & Voochees, Inc.; Patrick Doyle, Finch Pruyn and Harold Loke, Jr., awards contest chairman, Ciba Co.

Pictured in the enclosed photograph, reading from left to right, are: John Huckle, Hudson Falls High School, winner of 2nd Prize; Paul L. Page, Imperial Color Chemical & Paper Corp., chairman, Eastern District; Leon H. Sparkling, English Department of South Glens Falls High School; Alan Forrest, Hudson Falls High School, winner of 1st Prize; Harry E. Gross, English Department of Hudson Falls High School; and James Fusco, Sandy Hill Iron & Brass Works, educational chairman, Eastern District

Drummond Grant Cole, and Earl Johnson presented the following slate of candidates:

Chairman, Richard Collins, Sandy Hill
Vice-chairman, Gordon Rabeler, International Paper
Program, Warren Lemke, International Paper
Treasurer, Wm. Montgomery, Finch Pruyn & Co.
Membership, John McCoy, Finch Pruyn & Co.
Publicity & Bulletin, Gunther Herwig, Finch Pruyn & Co.
Secretary, Richard Hurley, West Va. P. & P. Co.
Asst. secretary, Carl Kritz, Sandy Hill
Entertainment, Grant Rauscher, International Paper
Educational, John Williams, Sandy Hill
Educational advisor, James Fusco, Sandy Hill
Junior awards (1 yr.), Harold Loke, Ciba
Junior awards (2 yrs.), Wm. Lord, International Paper

It was moved and seconded that the nominations be closed. The motion was carried. A second motion was made and seconded that the secretary cast one vote for the slate of officers as listed. The motion was unanimously passed.

A few closing remarks were made by James Field on the excellent program just concluded.

The meeting was adjourned at 10:15 p.m.

V. W. Potts, *Secretary*

Maine-New Hampshire

A meeting of the Maine-New Hampshire Section of TAPPI was held at the Hotel Elmwood, Waterville, Me. on Thursday, April 28, 1960.

There was a mill visit in the afternoon to the Scott Paper Co., Winslow, Me. Dinner was at 6 o'clock and there were 147 members and guests in attendance. Andrew Chase, chairman of the Maine-New Hampshire Section, served as chairman for the meeting. The welcome was given by George Blessing, general manager, Northeast Div., Scott Paper Co. The theme of the program was "Continuous Hypochlorite Bleaching," and the title of the papers are as listed below:

1. "Operation of a Continuous Hypochlorite Bleach Plant," by Douglas Fink, assistant sulfite superintendent, Scott Paper Co., Winslow, Me.
2. "Technical Control in Continuous Hypochlorite Bleaching," Roland Bilodeau, process control engineer—Pulp Mill, Scott Paper Co., Winslow, Me.
3. "Instrumentation of Continuous Hypochlorite Manufacture," John Bravacos, Foxboro Co., Foxboro, Mass.

Single Stage Hypochlorite Bleaching

Douglas G. Fink

In the pulp makers' world of today we generally hear of two-stage, three-stage, and even seven-stage bleach plants and then to top it off, there is the much discussed and popular chlorine dioxide stage of bleaching; but the father of all bleaching, single-stage hypochlorite, is far from dead. Tonight, I would like to describe the construction and operation of a modern up-to-date single stage hypochlorite plant.

At the Winslow plant of Scott Paper Co., we have a three-stage bleach plant and operating in parallel with it a modern continuous single-stage plant. It is the latter we will consider.

Our plant has a designed capacity of 250 tons per day and consists of 8 ft. by 16 ft. thickener furnished by the Improved Machinery Co. A heater-mixer furnished by Dorr-Oliver and $16^1/_2$ ft. by 60 ft. tower. The tower has the conventional conical bottom from where the finished pulp is slushed to storage. The mining system is furnished by Dorr-Oliver and consists of two 30 in. circulators powered by a 40-hp. motor and six dilution nozzles providing white water for dilution.

Pulp prior to bleaching is pumped through a Foxboro magnetic meter with consistency control by Kalle in the range of 2.80 to 3.0%.

Dilution prior to thickening is done with recycled white water from the thickener. Excess water is returned to the screen room white water system.

Bleach liquor, calcium hypochlorite, is pumped from a storage tank 40 ft. below to the mixer through a 2-in. Uscolite line. It is measured by a Fischer-Porter Flowrator and controlled by a Foxboro remotely operated valve.

Necessary steam is supplied from a 60-lb. line through a remotely operated Mason-Neilon control valve.

Finished pulp in the normal range of 74 to 77 G.E. brightness is washed by two washers which were converted from thickeners. All pulp is stored in high density tanks awaiting its use by the paper mill.

The plant was engineered by the Chas. T. Main Co.

BLEACH LIQUOR

Bleach liquor which is used by both bleach plants is manufactured continuously by injecting a controlled flow of chlorine into lime water which is batch made. The chlorine control is automatic and is dependent on the differential temperatures of the lime water and the bleach liquor at the end of the reaction tube. Finished bleach liquor is put through a Dorr-Clone centrifugal cleaner before storage.

The lime water is made up about every three hours in an agitated tank by manually adding strong lime and water. Since we are continually pumping out of the tank while a new batch is being made, we are constantly exposed to either a too weak or a too strong solution being pumped to the reaction tube with its consequences.

It is known that an insufficient aklalinity in bleach liquor produces too fast a reaction and a degradation of fiber. However, we have also learned through bitter experience that too high an alkalinity with its resultant high final pH produces dirty pulp even though the brightness is within the desired range.

When the final pulp is 2 or 3 hr. behind that entering, you can imagine how fast off-grade pulp can pile up before proper liquor adjustments show up in the finished product. Having our customer, the paper mill, so close to us, we have to be ever so diligent in keeping the product within standards.

We hope to soon engineer a continuous system for making up lime water using a new type device for sensing the density.

Douglas G. Fink, Assistant Pulp Mill Superintendent, Scott Paper Co., Winslow, Me.

In addition, we plan to make improvements in the bleach liquor system probably changing over to a newer type sensing device such as the ORP system developed by the Diamond Alkali Co.

BASIC OPERATION OF PLANT

Before the advent of the second single-stage bleach plant, we manned the three-stage plant with an operator and a helper. These two men also operate the new plant helped by our automatic controls.

In starting the plant, the helper controls thickener speed, vat level, and stock flow manually from the console at the thickener level. When he is satisfied that things are right, he notified the operator who then takes over the automatic control at the instrument panel located on the three stage bleach plant operating floor. From then on, the control is from the panel with a TV camera watching the thickener operation; the picture transmitted to the panel. Stock flow, liquor flow and washer speed are synchronized so that changes in stock flow are compensated by changes in the other variables. Tower level is automatically controlled by a remote operated DeZurick stock valve on the line feeding the pulp washers. Dilution water is manually controlled and is adjusted by the operator in accordance with his observation of consistency of the finished pulp.

Stock Flow

Unbleached pulp for the bleach plant is deckered and stored in a stock chest of capacity of 2 tons. The pulp is pumped by a vertical Bingham pump with a continuous sample provided the Kalle consistency regulator which controls the quantity of makeup water put back in the stock chest. The pulp is sampled every 2 hr. for consistency and every half hour for TAPPI permanganate number. These data are provided the bleach operator who through use of a nomograph developed locally determines the gallonage of bleach liquor that is required.

Problems in this area are consistency control at higher tonnage rates and the inadequacy of the 2-ton chest when the plant shuts down suddenly. Although we have a fine intercom system between departments, you can readily imagine the amount of pulp that can overrun the tank before the screen room stock flow can be shut off. However, these incidents are rare.

Bleach Liquor Flow to Mixer

As stated earlier, bleach liquor is controlled by a remotely operated control valve with the liquor measured by a flow rator.

Our principle problem in this phase is caused by pieces of lime scale which get caught in the float. This in turn causes the control valve to start closing and if it isn't caught soon enough will shut off all the liquor. After an upset or two of this nature, we installed an automatic flusher which opens the control valve wide open every half hour. We also installed a bell and a red light which activate when the control valve is either wide open of fully closed. These changes helped things tremendously but an occasional upset was still to be had. In the original installation, the flow rator was located on the mixer floor 40 ft. above the operating floor. To help matters, we brought the flow rator down and reinstalled it so it can be constantly observed. Finally, we hope to have installed by Memorial Day a Foxboro magnetic meter in this service. This should put an end to this problem.

Mixer Consistency

Our large thickener does not give us as dry a sheet as we would like especially at high rates. We feel that this is a problem of vacuum and sheet formation. We have plans on the drawing table for getting higher consistency on this thickener.

Pulp Dirt

As mentioned earlier, control of dirt is very important in this plant because there are no screens between the plant and the paper mill. We sample the unbleached pulp hourly for dirt counts and endeavor to keep the maximum retention time and fair chlorine residual to help bleach out the shives. Our principle control of dirt within the bleach plant is in the control of pH. A contemplated change soon forthcoming will reactivate an idle bleach liquor tank which will minimize fluctuations of lime water strength when a new batch is made. Chlorine, lime water, and water lines will be provided so that final adjustment can be made before the tank is put on the line.

Brightness Control

The pulp is sampled hourly for final brightness and adjustments of bleach liquor; tower level and temperature is made accordingly. Since the stock line to the washers is located in the basement, it was necessary to pipe a sample line to the operating floor. This pulp ran continuously into a pot and then back to the unbleached tanks. For pulp accounting reasons, it was decided to return this pulp to the line from which it came. This was accomplished by installing an orifice downstream in the line thus providing a differential pressure which causes the pulp to flow through the sample line and back into the stock line. A 12-in. Plexiglass pipe is installed at the operating floor so that the color can be continuously observed. A quick opening valve is provided to sample for brightness, dirt, residual chlorine.

Pulp Accounting

Here is a problem that is hard on which it is to account. Since we do not dry or lap our production, all pulp production must be calculated from measurement of slush in the several places. We measure all unbleached pulp through an Impco paddle-type stock meter with consistency controlled by a DeZurick regulator. Then the three-stage bleach plant input is measured by another Impco meter also with a DeZurick consistency control. Finally, the single stage bleach plant has its Foxboro magnetic meter with a Kalle regulator.

Ideally, the sum of the two bleach plant meters should equal the unbleached meter but such is not the case. Empirical corrections are being applied to help the situation. Basically, we believe the problem is in consistency sampling and measurement which is extremely difficult in the ranges we operate.

SUMMATION

In summation, a single stage bleach plant such as we have at Winslow offers many challenges but has proved itself to be very efficient and flexible. For example, we are able to produce fully bleached pulp of 84 to 86 brightness at 90 lb. chlorine per ton, a semibleached pulp of 74 to 77 brightness at 65 lb of chlorine per ton, and on occasion even pulp to 69 to 70 brightness.

As I stated initially, single stage bleaching is far from dead.

Presented at the meeting of the Maine-New Hampshire Section of TAPPI, held in Waterville, Me., April 28, 1960.

Technical Control in Continuous Hypochlorite Bleaching

Roland E. Bilodeau

TONIGHT we will talk about technical control in continuous hypochlorite bleaching. As you are well aware the technical control aspects of single-stage continuous bleaching are many. But before we plunge into any detailed dis-

ROLAND E. BILODEAU, Process Control Engineer, Pulp Mill Scott Paper Co., Winslow, Me.

cussion, I would like to briefly outline to you what we in Scott call the technical control idea.

Technical control, then, is the control of every production sequence from raw material to the finished product so as to achieve highest quality, top efficiency, and lowest possible cost in production.

We believe the success and growth of an organization depends upon how well this idea is carried out.

When applied to continuous bleaching the technical control idea results in two specific areas of control. (1) process control and (2) quality control.

The major process control variables which must be considered when operating a continuous bleach plant are: (1) plant through put rate, (2) pulp bleach requirements, (3) bleach addition, (4) bleaching pH, (5) final pH, and (6) residual Cl_2.

Of all these variables through rate and bleach requirements are most difficult to control in a continuous operation.

By its very nature, slush stock is difficult to measure. We utilize a Foxboro flowmeter and Kalle consistency regulator to control stock through-put

One of the immediate control problems in this area is to determine the exact consistency of the stock passing through the flowmeter. At the consistency lever which the plant operates (2.8 to 3.0) considerable difficulty has been experienced in obtaining a representative sample.

Initially, a sample from a flush tap in the main stock line was utilized. This setup produced low consistency values. An insert type sampler produced high consistency values. Presently, we are using an angle insert type. From this sampler we take samples on a 2-hr. cycle for consistency testing. This value plus the gallons per minute reading from the flowmeter has proved adequate for establishing through-put rate.

With through-put rate established pulp bleach requirement is the next important control variable. Bleach requirement varies with the bleachability of the pulp, the consistency of the incoming stock, and the final bightness of the pulp desired. The bleachability of the pulp is one of our biggest variables in that since we have ten digesters which are cooking on a given cycle and all are feeding to one single input point we are somewhat apt to get quite a variation in bleachability values. In order to cut down as much as possible on probable upsets, due to variations in our pulp coming from our different digesters, we must blend pulps in order to overcome variations of "hard" and "soft" cooks coming "back to back" to our bleaching system. Such drastic changes, as can well be understood, can cause undue upsets due to wide differences in bleach liquor requirements and can cause either overbleached pulp to occur or worse, unbleached pulp—pulp that didn't get treatment in time. Blending is very important since we are doing bleachability tests only once every half hour and any great change in bleachability of the input pulp between tests can cause a serious amount of improperly treated stock to get into the system. One ton of poorly bleached stock can sometimes contaminate as much as 5 tons of good stock. In order to overcome variations we have tried, whenever it is feasible, to run all "like" permanganate number pulps together and tried to blend the highs and lows so as not to have drastic swings.

Thus, now that I have mentioned consistency, through-put, rate, and bleachabilities perhaps I should discuss the nomograph which we use to correlate these factors. This nomograph is used to help facilitate the calculations necessary to determine the proper amount of bleach liquor to add to these pulps under the afore mentioned varying conditions of consistency, bleachability, and flow rate.

Simply, the nomograph lists stock flow rate in gallon per minutes, consistency and production rate in air dry tons per day. With the knowledge of the first two variables, consistency and flow rate, the third can be calculated. This new figure plus the knowledge of the bleachability of the stock we can now determine the bleach requirement necesssary in pounds of chlorine per minute necessary for the particular pulp. This figure, along with a knowledge of what the strength of the bleach liquor in use is, in pounds chlorine per gallon gives us the opportunity to calculate bleach liquor requirements in gallons per minute required on the basis of bleach requirements necessary to bleach to a final 70 brightness. In order to allow the bleach plant a little more flexibility of operation the last part of this nomograph has been developed. This is simply an adjustment for a higher brightness pulp such as if a 75 brightness pulp is desired then a certain per cent more than the normal requirement for 70 brightness pulp would be needed and possibly a factor of 1.1 instead of say the usual 0.8 would be in order. Thus by use of the known bleach liquor requirement for 70 brightness pulp with the new factor (operations) the new bleach liquor flow rate could be determined.

The next thing to consider in the process control of single-stage bleaching is initial pH control. This is a very important phase of the operation. Since we are using unsettled bleach liquor there is the possibility that we may use too much lime to chlorine in our bleach liquor makeup resulting in too high an initial pH. If this is the case, then, the final pH is likely to be too high and the reaction may not proceed to exhaustion and the resulting pulp will be unbleached and shivey. Thus, in order to maintain proper control over initial pH sample of the pulp is taken at the mixer, on an hourly basis, and pH of stock is checked.

Of course, if the pH of the initial stock is too low, this would indicate not enough bleach or not enough lime. If there isn't enough bleach then a quick exhaustion of the chlorine may occur and an underbleached pulp may again occur which would be also dirty and shivey

A second control test which is conducted at the mixer incidentally is a consistency test. The purpose of this test is to insure good consistency control over the thickener in order to have good uniform consistency and good fiber to bleach ratio during the bleaching cycle. The approximate range which we strive to maintain after the mixer is in the 10% range after the bleach liquor has been added.

As another assist to the operators in order to give them an idea as to what to expect for brightness at the base of the tower, a quick brightness test has been devised. A 50 to 75-g. sample of pulp (taken just after the mixer) is heated gently over a burner to approximately 140°F. to speed up the bleaching reaction. When exhaustion is reached (as determined by sprinkling a little bit of starch KI solution on a small portion of the sample) a brightness sheet is made and the brightness level is determined on a photovolt brightness machine. This test takes approximately 10 to 15 min. to perform and is quite indicative as to what to expect at the end of the retention time in the tower. This test is especially helpful when the plant is in the midst of difficulties whereby too much or too little bleach has been added. It gives the operator a quick look at what he is doing and allows him to get back in proper operation more quickly.

Up until now we have discussed the process control aspects, but now I would like to devote a little of my time to the subject of quality control. The major quality aspects with which we are most concerned are: (1) brightness, (2) dirt, (3) strength-fraction, (4) pitch, and (5) grit.

To take them in order listed above, brightness is the first and one of our primary controls. We attempt to maintain our brightness range in the 73 to 77 range. Any pulp above or below this range is usually segretated in storage and used in grades where brightness is not of prime importance. We are able to maintain acceptable control over brightness more than 90% of the time. Brightness samples are done at least once an hour when the operation is steady and more often when difficulties occur. Brightness samples are obtained at the pot which you have seen located near the lab and the viewing

section made of plexiglass is also under constant observation to spot any variations which may take place in between tests.

The second on the list, and of no less importance, is dirt control. Dirt levels determine pretty much the acceptance or rejection of the paper which will be made with the pulp in process.

Dirt samples are taken once every fifteen minutes and dirt counts are performed by comparison methods on sheets of a fixed basis weight (i.e. 100 lb. 24 × 36—500). Dirt is counted on the basis of number of specks and dirt area in parts per million. If for any reason the dirt or brightness tests are out of line the tester notifies the operator and foreman in charge so as to rectify the problem as soon as possible. The foreman or operator makes certain that these pulps are stored in such a place so that they can be handled in the papermaking process without affecting the quality of the paper being made.

We do not do strength tests on our pulp as such in the pulp mill but we do a Bauer McNett fiber classification test on the pulp to determine the degree of degradation which has taken place within the operation. The fractionation breakdown of the pulp gives us some idea as to how well the pulp in process will act in the grades for which we are making it.

Pitch is not a prime problem in the bleach plant, but is a definite problem to be contended with on our paper machines, and seems to be more or less of a problem at various times and seasons. The reason for pitch precipitation is not completely understood and many trials have been made with varying degrees of success.

Lastly, the pulp is washed on 8 by 8 and 8 by 12 washers and periodically samples of the washed stock are tested for residual by simply spraying the surface of the sample with a starch KI solution. A small sample of filtrate is also saved from the pulp on the belt going to the storage tanks and residual tests are done on a once a shift basis with $N/50$ sodium thiosulfate to determine the amount of residual present.

In repetition, in the maintenance of quality of the pulp, it has been found that no matter how much good material is made it takes only a small amount of off-quality pulp to make a large amount of rejectable paper. Thus, it is imperative, that tight controls be maintained on all tests, that no let-up be allowed in the proper operation of the equipment, that rigid self-inspection be maintained by the operators themselves in order to keep "bumps" down to a minimum, and wherever possible institute better and more controls if necessary over the whole operation.

In summation it is obvious that through the application of process control and quality control to our continuous single-stage bleach plant, we have satisfied the requirements of the technical control idea and insured highest quality production at top efficiency and lowest cost.

Presented at the meeting of the Maine-New Hampshire Section of TAPPI, held in Waterville, Me., April 28, 1960.

Instrumentation of Continuous Hypochlorite Manufacture

J. G. Bravacos

Increased production of bleached pulp during the last 30 years has resulted in a need for a more economical method of bleach manufacturing than the conventional batch process. The modern continuous systems meet this requirement. Today's modern continuous systems offer many advantages over the older methods. A full-time operator is not required. Large production and storage tanks have been eliminated. Chemical losses have been reduced and the bleach solutions produced are at more uniform concentrations. These modern systems, in general use for more than five years, have proved to be economical and completely reliable throughout the pulp and paper, textile, and domestic bleach manufacturing industries.

Both sodium and calcium hypochlorite are used here in the New England area on about a 50-50 basis. Both types lend themselves easily to continuous processes by the use of analytical instruments.

The mechanics of continuous sodium hypochlorite manufacturing operation are relatively simple. Caustic and water are mixed to yield about 4% caustic soda solution. This caustic solution and liquid chlorine are mixed to produce sodium hypochlorite with about 30 g. p. l. of available chlorine and about 4 g.p.l. of excess caustic. These are two important jobs done by two standard process instruments.

First is the caustic dilution controller. The concentrations of caustic in the ranges up to 10% are measured very accurately by conductivity. The conductivity varies directly as the concentration at a given temperature. An electronic instrument is easily calibrated in terms of caustic concentration with automatic temperature compensation. A variety of cells is available for this job. There is a plastic type that will stand up well in 50% caustic and will fit right into the pipe line for use under pressure. A pneumatic controller operates either a control valve in the line or the speed of the caustic pump. The number of dilution steps varies with mill practice. One mill here in Maine is currently controlling a single dilution step from 50% caustic to 3.9% to $\pm 1/10$ of 1% caustic at a rate of 5 g.p.m. Probably they could get even more accuracy with higher flow rates.

The chlorine addition to the caustic solution is controlled by an oxidation reduction potential controller commonly known as ORP or Redox. This millivoltage measurement is directly related to the ratio of excess sodium hydroxide to available chlorine. A normal instrument millivoltage range of 200 to 800 millivolts covers a ratio range of 0.02 up to 60 of excess sodium hydroxide to available chlorine. The measurement pickup is by a platinum and silver electrode assembly mounted either in a pipeline or the overflow from a mix tank to storage. A variety of other cells is also available for this job.

An electronic instrument picks up the small voltage and pneumatically controls the chlorine control valve that is installed just upstream of the barometric loop. The ideal set point for your bleach requirements may take some experimentation, but there is an abundance of data available on this application. There are plots of millivoltage versus concentration of the original caustic and available chlorine as well as millivolts versus ratio of excess sodium hydroxide to available chlorine. But because you now can have real control over your hypochlorite, you can truly find the ideal bleach strengths for your particular pulps.

The machinery of a sodium hypochlorite plant usually would include a hypochlorite storage tank for probably a 10 hour supply, a caustic pump, a mix tank or mixing coils and a hypochlorite transfer pump. Another instrument that would normally be used in this plant is a level recording controller for the hypo storage tank. This operates a pneumatic valve on the water line. As the level in the tank increases toward the set point, the water flow decreases. The caustic concentration controller then decreases the caustic flow and the ORP decreases the chlorine flow. All three flow rates—water, caustic and chlorine—decrease or increase together, but each under its own individual control.

Sometimes it is advisable to have flow meters on both the caustic and chlorine as the complete operating and control panel is always located some distance from the actual hypochlorite plant and naturally contains the pushbuttons, etc., as required.

The operation of this plant is obviously simple and one operator usually handles this job along with many other

John G. Bravacos, Foxboro Co., Foxboro, Mass.

duties. Maintenance of these instruments is very moderate. All are standard industrial process instruments and the only maintenance required on the electrodes is the replatinizing of the conductivity cell about once every 3 to 4 months. The replatinizing job consists of removing the cell from service for about $^1/_2$ to $^3/_4$ of an hour. The ORP cell should be wiped clean at 1 to 2-week intervals. Other maintenance is standard for these pneumatic controllers. Actually, many instruments in mills today have much harder and more difficult processes to control. The additional maintenance load of a hypochlorite bleach plant is really very light and you have an automatic, continuous sodium hypochlorite manufacturing process.

The calcium base hypochlorite manufacturing process is mechanically only slightly different from the sodium base and the instruments are quite similar.

Dilute lime slurry is reacted with chlorine passed through a centrifugal separator, and then to storage. Various methods are used to obtain a dilute lime slurry depending on varying mill factors. Control of dilute lime slurry is generally adequately handled by a density controller. The density measurement is usually made in a density column. Lime slurry at about $^1/_2$ to 1 lb. per gal. is pumped out of the storage tank and through a vertical expanded section of pipe. Pressure taps spaced about 15 ft. apart measure the specific gravity. A simpler density column is an expanded pipe open-ended at the top; a diaphragm type differential pressure cell is mounted at the lower end. A fixed head equal to the vertical height of water is imposed on one side of the d/p cell and the diaphragm side feels the changes in specific gravity of the lime slurry.

A pneumatic control valve regulates the flow of dilution water to the section of the pump or the mixer just ahead of the density column.

The reaction of lime water and chlorine is controlled by ORP. This measurement of the hypochlorite is taken after the separator and uses the same ORP equipment as the sodium base. The millivoltage measured is directly related to the ratio of excess lime to available chlorine and pneumatically controls the chlorine control valve that is mounted just upstream of the barometric loop.

In calcium hypochlorite ranges below 25 g p. l. of available chlorine, the millivoltage reading is the same for the initial lime concentrations from 30 to 44 g.p.l. At higher chlorine concentration, the curves are still relatively flat. The initial lime concentration can vary considerably before the ORP reading will change at the same available chlorine. The excess lime, of course, changes and this excess is not particularly harmful because it is utilized later in the pulp bleaching process. Therefore, only a reasonable degree of accuracy is generally required for the dilute lime concentration. Density columns give more than ample accuracy for this application. However, beta gages are available to measure lime slurry very accurately if the application warrants.

Other instruments that are normally used with this plant are level recording controllers on both the lime slurry and hypochlorite storage tanks, plus equipment as required before the dilute slurry tank. Again the complete control panel is located some distance from the actual hypochlorite plant and the operator has many other duties.

Maintenance of these instruments is slightly more than the sodium base system due to the presence of lime. The maintenance required varies from mill to mill and apparently is inversely proportional to the amount of operating time. The density controller and tank level instruments are sometimes purged systems and, if so, should be checked weekly. The ORP cells should be wiped clean about once a week. Here again there are many more difficult processes that instruments are controlling in your mills today.

The instruments that control the important reactions of hypochlorite bleach plants are truly analytical and they accurately measure and control from the final product itself. Some day all processes will be measured and controlled by quantitative instruments.

Presented at the meeting of the Maine-New Hampshire Section of TAPPI, held in Waterville, Me., April 26, 1960.

Delaware Valley

The Delaware Valley Section of TAPPI held its monthly meeting on April 28, 1960, at the Engineer's Club in Philadelphia. Featured speaker at this meeting was Richard M. Sinclair, president of The Sinclair Co., who spoke on the problems faced by wire manufacturers in the production of fourdrinier wires. A summary of Mr. Sinclair's presentation follows.

THOMAS P. CZEPIEL, *Secretary*

Fourdrinier Wire Manufacture

Richard M. Sinclair

IT WAS my intention to present to those present the problems faced by wire manufacturers in the production of fourdrinier wires, the problems that are faced mutually by the wire manufacturers and the paper mill operators, and to describe as fully as possible the actual steps in the production of a fourdrinier wire. (A diagrammatic scheme of the wire loom was presented to help picture these steps in fabrication.) It was called to the attention of those present that each individual wire in a fourdrinier wire is in actuality an individual and must remain as such from the actual start of preparation for production right through the use of the wire. As an example, a no. 70-mesh wire cloth, in the warp direction alone, for a 200 in. wide wire there are 14,000 of these individual wires.

Wires used by the manufacturers vary in size from 0.0035 to 0.028 in. in standard paper mill grades and meshes. The various steps of weaving being termed as beaming or warping on, threading in, the actual weaving operation including a discussion of the shuttle operation, methods used to keep the wire flat, etc., were discussed. It was pointed out that among the more important controls to insure quality were the checking of both warp and shute diameter, the chemical content and physical properties such as elongation, tensile strength, and yield. To insure proper shute count it is required that the weaver check this every six to twelve inches, as well as checking the crimp of the wire as it is weaving to insure proper knuckle formation.

RICHARD M. SINCLAIR, President, The Sinclair Co., Holyoke, Mass.

Richard Sinclair of the Sinclair Wire Co. addressing the April 28 meeting of the Delaware Valley section of TAPPI in the Engineers' Club, Philadelphia

It was pointed out that the production of fourdrinier wires is a high risk business because of the number of accidents that can happen during the weaving operation and a discussion of the safety devices applied to looms to help prevent such accidents and insure quality was undertaken. It was specifically called to the attention of those present that with the number of warp wires present in a fourdrinier wire it is almost a complete impossibility to weave an entire wire without having to piece a number of these together. These are sometimes very apparent through a welding technique used to accomplish a continuous wire being present throughout the length of fourdrinier wire itself; and further that the welding technique was not used always but the two ends were pieced together which was sometimes apparent; and those present were assured that this did not affect the quality of the wire in any manner whatsoever but would be a normal expectation as a condition of any fourdrinier wire.

Special treatments of fourdrinier wires were discussed to include reinforced edges, the reinforcement of seams, oscillation of the fourdrinier wire, etc. The techniques to accomplish these were discussed as well as the purpose and the usual requirements for such special treatments. The inspection, seaming, and finishing operations were discussed including the developing of the brazed seam as it now exists, the fact that the brazed seam is observed by the seamer through a microscope as it is being inserted, inspection of the seam following insertion wire by wire through a microscope, as well as so-called sewed and pin type seams that are in use. Again special treatments in the finishing operation were discussed to include leveling of the wire, relieving of the edges, seam reinforcement, plastic edges, plastic coated seam, as well as the normal finishing operations which would insure squareness of the wire, inspection to be sure of proper length, the stretching of the wire to prevent an over-stretching condition on the paper machine and the final inspection to check the running of the wire, its oscillation, track, etc.

It was pointed out to those present that a fourdrinier wire should be inspected as soon as possible after receipt in the mill and it was suggested that shipping damage be looked for for the protection of both the mill and the wire manufacturer. It was discussed that shipping damage could occur from dropping, from bumping boxes with fork-lift trucks which have been known to cause damage, from extreme end shock caused by humping of railroad cars, sudden stops in trucks, etc. It was also pointed out that opening of the box containing a fourdrinier wire should be done very carefully because damage has been done to the fourdrinier wire in opening boxes.

A discussion of the causes of wear and failure of wires and their particular actions was entered into to include abrasion, spot wear, hanging, scaling, seam corrosion, shute wire corrosion, electrolytic corrosion and the size of rolls and angle of bends in rolls on the paper machine. The question was raised as to how to measure proper wire life. The two most common measurements being number of tons made or number of days or hours run. It was questioned that these presented the entire picture, it being felt that other factors should be accounted for in making this measurement. These other factors included chemicals in the stock which would affect its pH, the filler used, the weight of sheet being made, and variations thereof during wire life, the water temperature and condition, the length of fiber, foreign material in the sheet, stability of flat box vacuum, change in motor loads. It was pointed out that the frequent inspection of wires in operation in the paper mills could in many instances help the papermaker secure longer life by discovering trouble spots and taking preventive measures at an early date. It was pointed out that especially where physical damage is involved corrective steps could be taken and save the paper mill not only a loss on the cost of the wire itself but probably of greater value to the mill would be the saving in down time and loss of production.

It was pointed out that requests for make and hold orders are increasing, and without a specific target data the weaving of the wire is entirely in the hands of the manufacturer and his limitations as far as production schedules and loads are concerned. Attention was called to the fact that any wire manufacturer intends to fulfill the requirements of his customer to the extreme limit of his ability, but the mills themselves can open the door to possible difficulty by anticipating a wire to be in stock in a manufacturer's plant, whereas, without a specific date, the manufacturer has not had the opportunity to make the particular wire because of the requirements for manufacturing wires on which specific dates were requested.

A short discussion also took place on the problem of cylinder wires and it was pointed out that the performance of a cylinder wire will be directly proportional to the condition of the individual cylinder mould, its rods and winding wire, with other conditions being equal. It was pointed out that the normal cylinder wire is of a plain weave whereas the standard fourdrinier wire is a twill weave. Special attention was drawn to the increased use of stainless steel cylinder wires, the development of the welded seam for stainless steel covers, trade name the Shurweld Seam by The Sinclair Co., and the use of such items as magnesium blocks and the grounding of a cylinder mould to combat electrolytic conditions that might exist through the use of combined copper base alloys and stainless steels in paper mill operation. It was emphasized that a paper mill contemplating the use of stainless steel covers should give sincere consideration to the rebuilding of the cylinder mould using stainless steel rods and winding wire as well as the covers.

Q. What impact will the new synthetic textile "wires" have on the fourdrinier wire business?

A. The development of synthetic textile "wires" has certainly been interesting. At the moment information on their operating characteristics is sparse and often conflicting. Conversion of the paper machine, i.e., the addition of stretching equipment, etc., for these new wires can be costly, but this may be offset by the reduced abrasiveness of the textile wires. Although, it is difficult to predict how important these wires may become, we at The Sinclair Co. do not foresee any immediate effect on our business.

Q. Are there special problems in manufacturing wires for paper machines such as the Stevens Former?

A. Yes. Wires for the Stevens Former must have nearly perfect surfaces. Because the stock inlet is practically on the wire and because the sheet is formed in a very short distance, the wire must be very tight and have extremely fine seams.

Southeastern Section

The following paper was presented at the March 25 meeting of the Southeastern Section held at Columbia, S. C.

Surface Properties of Wood Fibers

Andrew J. Chase

After wood pulp has been prepared by the pulping and bleaching processes there remain many other operations and processes that are necessary to convert it to a consumer product. These operations may be either physical or chemical by nature and in most cases they occur on external surfaces of the fiber structure. Therefore, it is reasonable to expect that the physical and chemical characteristics of the fiber surface will have great influence on the manner in which a pulp suspension or paper sheet will respond to the papermaking operations.

Washing, filtering, mechanical refining, and drying are physical operations that are common to all pulp and paper mills. Coloring, sizing, saturating, and coating are some of the processes that may be a combination of physical and chemical treatments. Without exception these operations and processes are concerned with adding something to the

Andrew J. Chase, University of Maine, Orono, Me.

fiber surface, mechanically altering the fiber surfaces to produce different physical characteristics, or with the movement of a liquid or vapor phase relative to the fiber surface.

For reasons which will become evident from the following discussion, wood pulp fibers have certain characteristics that are common to colloidal materials. Therefore, it would be well to review briefly some of the definitive properties of colloidal systems.

Weiser (*1*) defines a collodial system as a heterogeneous or dispersed system of at least two phases, one by which, a finely divided or dispersed phase, is more or less uniformly distributed in a continuous phase, the dispersion medium. If colloids are to be unique, the phase "finely divided" requires some further explanation. The qualifying size range for a colloidal particle can rather arbitrarily be set at 10 to 5000 A. This eliminates from the category of colloids ordinary molecules whose dimensions are generally less than 10 A. However, the molecules of many organic compounds are large enought to be within this size range.

The upper limit of this range merges into what can be classified as coarse dispersions or suspensions and it is within the resolving power of an ordinary microscope. A particle need have only one dimension in the specified size range to qualify as a colloid. Cellulose molecules are less than colloidal size in width and thickness but their length places them firmly in the category of colloidal materials. On the other hand, certain thread-like or fiber-like particles that are many thousands of Angstrom units long may still be in the colloidal category insofar as their other dimensions are concerned. Many colloidal materials are aggregates of molecules rather than single molecules. Thus we see that colloids can be classified according to size and cellulose, the principal component of pulp fibers satisfies the size requirement.

Colloidal systems must, because of their fine state of subdivision, possess very large external specific surface areas, i.e., large external area per unit mass or volume of the dispersed phase. For example, carbon blacks and charcoals having pores of colloidal dimensions have specific surface areas of 1000 to 10,000 sq. ft. per g.

The shape of particles can, of course, influence greatly their surface area. Calculation will show that one gram of spherical glass beads having diameters of 1000 A, intermediate in the colloidal range, will have a surface area of 400 sq. ft. If each bead were flattened to a disk having a thickness of 10 A. the area per gram would be increased to 14,000 sq. ft. If each bead were pulled into rod shaped particles 10 A diam. their specific area would be increased to 27,000 sq. ft.

It is a fact that, because of the large specific area, a very large percentage of the atoms and molecules of which colloidal particles are composed exist at the surface. Surface atoms and molecules exist in a different environment than those in the interior and therefore are conditioned to act somewhat differently with respect to their surroundings. It is apparent, therefore, that the physics and chemistry of these surfaces determine to a very large degree the properties of the total material and govern in large part its behavior with relation to other materials. Thus particle size, specific surface area, and proportion of total material existing at the surface can be the distinguishing characteristics for the colloidal state.

A material will display changes in many of its properties as its degree of subdivision passes through the series: coarse dispersion, colloidal particles, individual molecules. For example, wood chips will adsorb matter, will react with light, will have some electrical charge on their surfaces, and will meet with some frictional resistance in moving through water or air. However, these effects are all quite negligible when compared with the overall effects which are produced when the chips are divided into fibers. Now much more material can be attracted and held to the surface, light scattering will be abundant, and movement of the fibers through water will be greatly retarded. The chemical reactivity of the fibers will be greater than that of the coarse chips. Their response to forces of agglomeration and dispersion will be greatly increased.

The primary component of the fibers of chemical pulps is cellulose. The fibrous elements, microfibrils, of which a fiber is composed, contain many cellulose molecules arranged roughly parallel to one another and with their long axes parallel to those of the fibrils. There is much overlapping of individual cellulose molecules and at points where several overlap a crystalline arrangement exists. Other portions of the fibrils have an amorphous structure. The amorphous regions, the spaces between individual fibrils, and the interfiber pores and crevices present collectively a very porous structure having a relatively large external surface area.

One gram of dry wood pulp fibers will contain from 5,000,000 to 12,000,000 individual fibers with 8,000,000 being a sound average. A softwood fiber will have an average length and diameter of 3 mm. and 0.03 mm., respectively. Assuming the fiber to have a continuous, nonporous surface its surface area would be 0.003 sq. cm. This value multiplied by the number of fibers per gram gives a specific surface area of 24,000 sq. cm., approximatly 26 sq. ft. Experimentally, the external specific surface of fibers has been shown to range from 5000 to 50,000 sq. cm. Such values have been obtained using liquid permeability and adsorption from solution methods of surface area determination. Much larger values have been reported from the results of measurements by gas adsorption methods. The surface areas that are measured by adsorption methods depend to a large extent on the size of the adsorbate molecule and the proportion of the surface which it can reach. It is reasonable to assume that much of the fiber surface available to gas molecules would not be of much importance in many of the papermaking operations where the fiber surfaces are involved with other fibers, large molecules, and relatively coarse particles.

A dry, unrefined fiber exists in the condition representing its lowest value of external surface area. When soaked in water it will swell and new external surfaces will be exposed. Mechanical action will produce more external surface in several ways. It will break the fiber transversely thus exposing some new surface; it will split the fiber longitudinally bareing more external surface, or it will fibrillate the exterior walls of the fiber creating a surface covered with many fibrils of microscopic size. It has been established also that much of the fibrillar structure resulting from mechanical action is of submicroscopic dimensions. Thus part of the fiber, the submicroscopic fibrils, interfibril capillaries, and some interfiber capillaries, are in the colloidal size range and systems of pulp fibers have many of the characteristics of colloids even though considered as a whole they are far outside the size limits. These are the parts of the fiber that account for a very large proportion of its external surface.

It has been postulated that there are cellulose molecules actually existing partially in solution on the surfaces of the fibril structure.

MEASUREMENT OF FIBER SURFACE

A number of investigators have studied methods of measuring the external surface of pulp fibers. Much of this work has, from a practical viewpoint, accomplished little of immediate value. However, the results have added to our knowledge of fiber surfaces and have in some cases substantiated hypotheses concerning the role played by the fiber surfaces in various papermaking operations and the effects produced on the fiber surface by certain physical and chemical treatments.

Surface area determinations of wood pulp fibers have been made by many methods. They include gas adsorption, adsorption from solution, permeability, microscope, and optical methods, and sedimentation rate. There seems to be very poor agreement among the various methods insofar

as absolute values of area are concerned. However, changes in surface area affected by certain pulp treatments are shown by all the methods.

The effect of beating and refining on specific surface area has been the subject of study by several investigators. The silvering method of specific surface area determination (*2*) is the method which is probably most familiar to people in the paper industry. It consists of forming a film of silver on the surfaces of the fibers by precipitation from a silver-ammonia complex solution. The quantity of silver, or indirectly the area which it occupies, is then measured by its catalytic decomposition of hydrogen peroxide. This method shows some correlation between the change of strength properties, specific surface area and beating or refining time. However it does suffer from a number of weaknesses. It is probable that many fines and fibrils are collapsed onto the surface of the fiber and thus not silvered individually and completely. Pores and capillary spaces may be sealed over before their surfaces become silvered. Thus this particular method gives relatively low values for specific area and as the weaknesses are magnified with increasing fibrillation it fails to show the expected *rate of increase* of specific area with time of refining.

Adsorption from solution has a number of drawbacks. Surface area must be determined from knowledge of the amount of solute adsorbed, and the effective area of the solute molecule. Adsorption of solvent can complicate the determination by making it difficult to calculate, by concentration differences, the amount of solute adsorbed. The manner in which the solute molecule attaches to the fiber surface can affect its coverage area and so certain assumptions concerning the magnitude of this area are usually necessary.

In spite of the inherent difficulties in this method, techniques have been developed, using dye solutions, which give reproducible results (*3*). These methods are rapid, precise, and may have some practical value as control tests.

Gas adsorption measurements of specific surface must be made on dry fibers. Very high area values are obtained by this method if the fibers can be maintained in a swollen, albeit dry, condition. Under comparable swollen conditions there are, of course, spaces accessible to the gas molecules which are inaccessible to the larger molecules employed in the silvering and dye adsorption methods.

Liquid permeability methods of surface area determination employ measurements of the flow rate of liquid through pads or plugs having various solids concentrations. The flow is caused by controlled hydrostatic pressure and the plug is composed of the material whose surface is being measured. Basically, the flow rate for a given pressure difference across the plug is controlled by the friction losses occurring at the fiber-liquid surfaces within the plug. There are certain experimental difficulties involved in this method. It is very important that the pad be formed from a uniformly dispersed pulp suspension, and that there be no net travel of solids within the pad during a measurement.

Specific volumes for pulps, calculated from liquid permeability data, usually are very high, ranging from 5 to 10 times that of cellulose. Part of this may be attributed to the high degree of swelling which fibers undergo in water. However, some of this volume is actually an envelope or covering of immobile liquid on the surface of the solid. It is the surface of this liquid envelope instead of the actual solid surface that is measured by this method.

When this method is performed properly its reproducibility is very good, probably better than those methods previously described. It shows the specific surface to increase progressively with beating time. It gives values for *unbeaten* pulps which agree with those given by the silvering and dye adsorption methods but gives higher values for *beaten* pulps.

Gas permeability methods give results which compare well with those obtained by liquid permeability methods. Microscopic methods of area measurement depend for accuracy on correct measurement of fiber dimensions. Such measurements become increasingly difficult as a pulp is refined and the fibers acquire very complicated shapes.

EFFECT OF DRYING ON SURFACE AREA

Drying of pulp fibers causes an irreversible loss of external surface area as measured by the dye absorption method. When pulp is dried the surfaces of fibrils, of interfiber and intrafiber capillaries are drawn together by surface tension forces and finally be secondary valence forces. The extent to which such segments can be compacted and bonded depends materially on the flexibility of the fibers. Nevertheless the total bonding will be determined largely by the amount of available surface area. When bonds are formed surfaces disappear. The irreversible bonding that occurs to some extent when fibers are dried decreases the surface available for bonding in subsequent processing and creates changes in physical characteristics.

Jayme (*4*) obtained data from swelling measurements which showed an appreciable loss (in the range of 35 to 40%) of available surface when pulps were dried from the slush to the oven dry state. E. F. Thode, (*5*) showed that the available external surface of sulfite pulp decreased with drying and that the rate and extent of decrease was related to the temperature and extent of drying, with one exception—the irreversible loss of surface at very low moisture content was shown to be independent of the drying temperatures 20, 65, and 100°C. used. It was also shown that strength properties of the pulp decreased as a result of the drying treatments. These decreases in strength appeared to be a function of the changes in surface area as measured by dye adsorption.

The effect of drying and heating on paper strength has been extensively investigated. Lyne and Galley (*6*) studied the strengths of hand sheets made of pulp previously dried to various solids contents ranging from 30 to 90%. The usual decreases in burst, tensile, and fold strengths were noted. Bulk and softness increases were also noted. Either heating the wet web prior to drying or the pulp suspension before formation of the sheet had effects on strength similar to those caused by drying.

In general, it can be said that a pulp that has been dried and then reslushed will respond differently to processing operations and will have different physical properties when formed into a sheet than will a slush pulp that has never been dried. The reslushed pulp may respond more easily to mechanical treatment but its strength properties will never equal those of the undried pulp. The fibers have lost some of the surface at which bonding and strength development take place. Their swelling power and flexibility have also decreased, thus lowering the amount of fiber to fiber contact and bonding that occurs during sheet formation. Tensile and bursting strengths are decreased, and a softer, bulkier, more opaque sheet is the result. These qualitative effects are well known generally in the pulp and paper industry.

Recent work (*7*) has been devoted to studying the development of sheet strength during the drying operation. Handsheets were dried to various solids contents and the remaining water was then removed by extraction with acetone. Subsequent removal of the acetone was accomplished by evaporation at 70°F. The solids contents to which the sheets were dried prior to the acetone treatment ranged from 30 to 90%. The results show that development in tensile and burst strength continues with water removal over the whole range of solids content with the greatest rate of increase occurring over the interval 60 to 80% solids. The specific volume decreased rather rapidly over the solids range 60 to 80% but there appears to be very little change in this property above 80% solids. These results confirm the conclusions of other investigators in that fiber shrinkage and fiber-to-fiber bonding continue until essentially all the water of swelling has been removed. This occurs at approximately 80 to 85% solids.

Tear strengths increased with water removal, reached a maximum at approximately 50% solids and then decreased rapidly over the 50 to 80% range. The rate of decrease slowed materially above 80% solids. This behavior in tear strength development is additional evidence of the fact that a large percentage of the fiber to fiber bonding occurs during drying through the solids content range of 50 to 80%.

Measurements of the scattering coefficients gave results which in general paralleled those of the strength tests. The coefficient decreased rapidly over the same solids range, 50 to 80%, with very little change taking place beyond 80% solids. It appears, from results of scattering coefficient measurements, that at 80% solids all bonded area that can be determined by this optical method has been consolidated. Therefore there is no material change in the scattering coefficient. However, there is some additional improvement in strength with further drying treatment. This is a result of fiber shrinkage and indicates an increase in bonding beyond that detectable by the scattering coefficient principle.

ELECTRICAL PROPERTIES OF FIBER SURFACES

Cellulose fibers normally acquire a negative electrical charge in water. Attempts to measure directly the surface potential of fibers have not been successful. However, several electrokinetic methods of measurement have been used and techniques developed by which the surface charge and charge density can be determined indirectly. Probably, the most widely used method is that which measures the "streaming potential" or "streaming current." Briefly, this method consists in forcing a pure liquid or solution through a stationary plug of fibers and measuring either the potential difference that is created across the plug or the current that flows as a result of the potential gradient. The surface potential of the fibers can be calculated from the streaming potential data.

The electrical nature of the fiber surface, the magnitude and sign of the surface charge, is a very important property. It plays a major role in determining the reactions between the fiber and various additives that are used in the papermaking processes. Retention of filler materials, dyestuffs, and sizing agents depends to a large degree on the electrostatic relationships between such materials and the fiber surface. Adhesion of fibers to surfaces of equipment may be partly a result of electrical attraction. Flocculation and settling or sedimentation of pulp furnishes may be affected by the charges on the fiber surfaces.

The use of aluminum sulfate by the paper industry is such a common remedy that it needs no detailed discussion. It is used as a retention aid for fillers and sizing agents and as a pH control. Most filler materials are negatively charged in water and thus are repelled by similarly charged pulp fibers. The positively charged aluminum ion from aluminum sulfate is attracted to the fiber surface thus reducing its negativity, and at sufficiently high concentrations actually creating a net positive charge on the surface. There exists much experimental evidence for the effect of various electrolytes on the surface charge of fibers. S. M. Neale, (*8*) showed that the negative surface potential of cotton fibers was decreased by the addition of electrolytes having monovalent cations to an aqueous suspension of the fibers. As the concentration of the electrolyte was increased the negative surface potential decreased. It was also shown that the adsorption of dyestuffs by cotton fibers changed the surface potential of the fibers. The changes were those which would be expected knowing the charge on the dye ion, i.e., the positively charged basic dye created a positively charged fiber surface and the negatively charged acid and direct dye ions made the surface more negative. E. F. Thode, and S. Htoo, (*9*) investigated the electrokinetic properties of unsized and rosin-sized pulp fibers. Their findings showed that unsized fibers are negatively charged when in dispersion with aluminum sulfate in amounts and at stock consistencies which prevail at the headbox. On the other hand the rosin-sized fibers were found to be positively charged at alum and size concentrations prevailing in stock preparation systems. It was postulated that the net positive charge in this case was caused by the positively charged rosin-aluminum sulfate complex being precipitated onto the fiber surface.

Studies have been made recently (*10*) on the surface charge of various materials of which paper machine press rolls are composed. The adhesion of fibers to press rolls is one of the problems encountered at the paper machine. "Picking" of fibers from the surface of the wet web disrupts the formation of the sheet and leads to build up of fiber on the roll surface.

The results of streaming potential measurements on various materials that are used for press rolls has shown significant differences in the electrical nature of their surfaces. In general, the surfaces of all materials investigated had a negative charge in water. The addition of various electrolytes and colloidal materials to the systems affected both the sign and magnitude of the surface charge. The effects were very pronounced for some roll materials and relatively minor for others. It was established that a very definite electrostatic attraction can exist between fibers and press roll and the magnitude of this attractive force is influenced by roll material, and by concentration and type of chemicals in the pulp furnish. A correlation was shown to exist between the fiber picking characteristic of press roll materials and the electrical force of attraction between such materials and fibers.

The effect of drying on the electrokinetic properties of pulp fibers has been the subject of recent study (*11*). Water removal was effected in a number of ways. Pulps were air dried at room temperature, oven dried at elevated temperatures, and in some cases water was removed by extraction with alcohol and acetone. After these treatments all samples were dried over phosphorus pentoxide for several days to assure that all attained the same final moisture content. These pulps were then soaked and reslushed in water and streaming potential measurements were made. In every case it was found that the electronegativity of the fiber surface was increased by a significant amount. No attempt has yet been made to correlate these findings with the effects of drying on other characteristics of fibers. There is some evidence that retention of filler materials is adversely affected by drying, i.e., a pulp that has never been dried will retain fillers more efficiently than will the reslushed pulp. It is possible that this effect is in part a result of the increase in the negativity of the fiber surface charge and the attendant increase in forces of repulsion between filler and fiber.

The degree of crystallinity existing in pulp fibers and its relation to fiber surface charge has been studied briefly (*12*). Undried pulps were given chemical treatments which are known to alter the ratio of crystalline to amorphous content. No attempt was made to measure the degree of crystallinity or the change in this characteristic that should have resulted from the chemical treatments. There was no change in the surface charge of the fiber as a result of these treatments. The significances of this is not apparent at the moment and conclusive results certainly are not warranted until further study has been completed.

FIBER SURFACE EFFECTS IN FLOW OF PULP STOCK

The movement of suspensions of pulp fibers involves the overcoming of frictional forces existing at surfaces. The surfaces involving fibers may be fiber-fiber, fiber-water, fiber-metal, if we consider one of the most prevalent cases of fiber movement in the industry, i.e., stock flow through pipes. It might be expected that as a fiber becomes more "hydrated" and surrounded by a shell of physically sorbed water the frictional forces existing between fibers and between fibers and pipe walls will be influenced less by the characteristics of the fiber surface. Specific surface area is one property of

pulp fibers that could have an effect on the friction existing during the movement of a pulp suspension. In general the greater the amount of surface the more friction will develop. However, if the creation of new surface also provides a *different* surface that will tend to be more effectively covered or lubricated by the dispersing liquid it would not be unreasonable to expect that frictional forces might even decrease. Such has been found to be the case in work done at the University of Maine. Pulps were treated mechanically in a manner which caused extensive external fibrillation. Friction loss measurements were made as the pulps flowed through a pipeline. It was shown that, at comparable flow rates, the friction loss decreased with decreasing freeness (increasing surface area) of the pulp.

It would be interesting to duplicate this work replacing the water, the dispersion medium, with an organic liquid. If the effects of increased surface area on frictional losses were reversed by this procedure, i.e., if friction were found to be proportional to surface area, the water "hydration" or "lubrication" theory would thus have some concrete support.

The addition of surface active materials to pulp fiber suspensions resulted in decreases in friction losses (*13*). Rather high percentages of wetting agents, 1.0, 2.0, and 5%, based on weight of fiber, were used. At pulp consistencies in the range 1.0 to 3.0% the decreases in friction loss were appreciable. It is postulated that the surface active agents effectively "hydrate" the fiber surfaces thus reducing the degree of fiber-fiber contact and friction. Efficient surface active agents should be effective at very low levels of addition. The optimum ratio of agent to fiber was probably exceeded in this work because no significant differences in results were noted as a consequence of increasing the percentage addition from 1.0 to 5.0%.

The settling rate and flocculation of pulp fibers in water is affected by the extent and nature of their surfaces as well as by their size and shape. As a result of some rather abbreviated experiments (*14*), the following generalizations can be made concerning settling rates of pulp fibers. In all cases settling took place in distilled water and the systems studied were of sufficiently low fiber content that the settling rate of any fiber was not influenced by the presence of other fibers.

1. Drying and reslushing a pulp increases its settling rate.
2. Settling rate decreases with decrease in fiber dimensions.
3. Ball milling or other refining treatment decreases the settling rate.
4. The addition of rosin-aluminum sulfate complex to the fiber surface decreases the settling rate.
5. The adsorption of a direct dye on the fiber surface decreases the settling rate.

Drying a pulp increases its settling rate because it lowers its surface area. It might be said that its hydrophilic nature is slightly retarded, if not permanently lessened, by drying. Thus water and fiber are more easily separated. This also should serve as an explanation for the fact that drying a pulp will increase its freeness.

Mechanical refining increases the external surface of the pulp and its water-holding power, particularly if the refining causes external fibrillation. This accounts for the decrease in settling rate when pulp is refined.

The results of the settling rate study probably are of only academic interest because they were obtained under conditions which have no practical implications at present.

BEATER ADDITIVES

The addition of certain materials to pulp fibers during the stock preparation will improve strength properties and drainage characteristics. Such materials probably are most widely used in instances where it is desirable to affect certain strength properties without concomitant effects on pulp freeness, or vice versa. Many studies of the use of such materials have been reported in the literature. Swanson (*15*) has presented a report that is a very comprehensive survey of the literature pertaining to this subject.

Typical of these "chemical hydrates" are various starches, cellulose derivatives, alginates, guar, and locust bean gum. They are all polymeric materials of relatively high molecular weight. Molecular structure is fairly complex for most materials although some are relatively straight-chain with a minimum of side branches and cross-linking. Their molecular size and structure precludes any appreciable amount of penetration into the finer structure of the fiber. The effects of their presence in the pulp furnish are limited to the external surface of the fibers and the most outstanding result of their presence is a change in the hydrophilic nature of the fiber surface. Hence they usually affect drainage characteristics and provide more potential bonding sites. It might be said that these materials do produce significant results because they make the fiber surfaces even more colloidal.

It was intended that this paper should stress the importance of the surface properties of pulp fibers in pulping and papermaking operations. The behavior of pulp fibers can, in many situations, be ascribed to their colloidal nature and thus can be anticipated and studied by using the theories and facts of colloid science. A review of some of the interesting studies of fiber surface properties has been presented. Admittedly, the review is meager in scope. Risking facetiousness, it could be said that only the surface has been touched.

LITERATURE CITED

1. Weiser, H. B., "Colloid Chemistry," 2nd edition (1948). John Wiley & Sons, Inc., Publishers.
2. TAPPI Standard Methods, T 226 sm.
3. Thode, E. F., *et al.*, *Tappi* 35, No. 8: 374–379 (August, 1952).
4. Jayme, G., *Papierfabr. Wochbl. Papierfabr.*, No. 6: 187–194 (June, 1944).
5. Thode, E. F., *et al.*, *Tappi* 38, No. 2: 88–89 (February, 1955).
6. Lyne, L. M. and Gallay, W., *Tappi* 33, No. 9: 429–435 (September, 1950).
7. Unpublished work.
8. Neale, S. M. and Peters, R. H., *Trans. Faraday Soc.* 42: 478–487 (1946).
9. Thode, E. F. and Htoo, S., *Tappi* 38, No. 12: 705–9 (December, 1955).
10. Unpublished work.
11. Unpublished work.
12. Unpublished work.
13. Unpublished work.
14. Unpublished work.
15. Swanson, J. W., *Tappi* 39, No. 5: 257–70 (May, 1956).

Presented at the meeting of the Southeastern Section of TAPPI, held in Columbia, S. C., March 25, 1960.

Ohio

On April 12, 1960, H. W. Whitaker, chairman of the board of The Mead Corp., addressed a large group of Ohio TAPPI members on the subject, "Miami University Pulp and Paper School and Its Prospects." The meeting was held in the University Center on the Miami Campus in Oxford, Ohio.

Mr. Whitaker traced the development of the Miami Pulp and Paper School from the initial ideas which were conceived by Ohio TAPPI to the present organizational structure at Miami. He stated that the school is helping to provide trained personnel for the paper industry at a time when our field needs more trained men to keep pace with its highly technical growth and expansion.

Mr. Whitaker stressed the large stake the Ohio paper industry has in the pulp and paper school at Miami. He called on people in the paper field to publicize the paper industry more and to attempt to convince promising high school and college personnel of what a fine industry we have, in order to attract the talented young men that are needed.

A tour of the facilities of the Miami Pulp and Paper School was made by many before the dinner meeting.

GEORGE E. MARTIN, *Recording Secretary*

Oxidation Potential for Control in the Bleach Plant

A. D. HARBIN, JR.

The Diamond chlorination cell is currently in use as a means of controlling bleach liquor production and pulp chlorination. The cell is composed of platinum and silver electrodes that are cast in a resin body of sturdy design for easy installation. A brief description of the cell development is outlined, and its general acceptance in a large number of pulp mills is discussed. From field experience, installations are described and data are presented to explain successful use of the cell in different mills. Examples are reported in which the chlorination cell is used both in bleach liquor makeup and pulp chlorination.

In recent years the measure of oxidation potential has proved to be an excellent method of controlling some important processes in the pulp mill. The theory of oxidation potentials and the application of oxidation potential control is contained in an excellent paper published in June of 1957 (*1*).

The Diamond chlorination cell is currently in wide use as a means of controlling bleach liquor production, pulp chlorination, control of pH, and other uses. It provides a reliable sensing element for measuring oxidation potential. The cell is composed of platinum and silver electrodes that are cast in a resin body and is designed for easy installation.* It is available in two models, which are illustrated in Figs. 1 and 2. The probe-type cell is 13 in. long and $^7/_8$ in. in diam. The platinum and silver electrodes are located 1 in. apart and 1 in. from the end of the probe. The end opposite the dissimilar metals is threaded with $^1/_2$ in., standard, pipe threads. The flowthrough cell which has the same metal electrodes is 6 in. long with an outside diameter of $1^3/_4$ in. and an inside diameter of $^3/_4$ in. Each end of the cell is threaded with standard $^3/_4$ in., female pipe threads.

In this paper we will report our field experience using the Diamond chlorination cells in the pulp and paper industry. It is our hope that this practical experience will be of help to others in the industry.

DEVELOPMENT OF THE CELL

As a background to the presentation of our field experience, a brief description of our work leading to the development of these cells seems to be in order.

Investigations which were responsible for this development were initiated in June, 1958. Initial laboratory work was done using cells of rather crude designs. On the bench our studies in bleach-liquor making were all batch-type experiments. Data are presented in Figs. 3 and 4 to illustrate oxidation potential measured in those tests. Next, in our pulp and paper laboratory continuous pilot plant trials were made in which we manually controlled chlorination of kraft, neutral sulfite semichemical, bagasse, and sulfite pulps, as well as deinked stock. Data with respect to reduction of potassium permanganate number with different levels of oxidation potential are illustrated in Fig. 5.

A. D. Harbin, Jr., Electro Chemicals Division, Diamond Alkali Co., Painesville, Ohio.

* A technical bulletin is available giving full description of the cell.

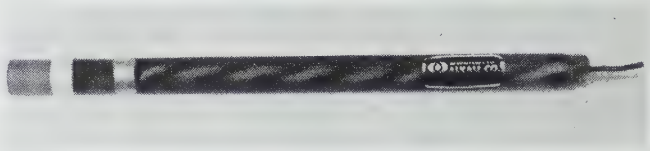

Fig. 1. Probe type chlorination cell

In May, 1959, we submitted the plans of our recent cell design to private contractors for fabrication. We now have placed one or both models of these cells in plants of 37 pulp and paper companies. To indicate geographical distribution, the cells are being used in mills located in 19 different states, in three Canadian mills, one mill in Germany, and one in Mexico.

GENERAL MILL EXPERIENCE

The data discussed here were obtained from plants in which we were actively engaged in cooperative studies. For use in controlling bleach solutions, observations have been made in various types of operations on both sodium and calcium hypochlorite. Data are also available from plants using the cells to control chlorination of various types of pulp including kraft (both hardwood and softwood furnish), neutral sulfite semichemical, sulfite, bagasse, and deinked waste stock.

The following general observations have been made from our plant trials. Sensing of milliequivalent voltage is rapid and positive. The effect of electrode polarization is easily controlled by occasionally reversing the polarity across the electrodes. The cells show remarkable resistance to their operating environment. To date no cell has failed in a recommended installation. In an effort to estimate life expectancy, we removed a flowthrough cell after nine months continuous operation in pulp chlorination, and could see no sign of deterioration. Figure 6 is a photograph showing a cutaway view of this cell. The sensitivity of the cell is far greater than the actual control sensitivity required in most systems.

Maintenance practice varies in different mills, but in all examples only routine inspections are necessary. In some plants at 7- to 10-day intervals it is the practice to momentarily reverse polarity in the cell; but in other plants cells are undisturbed for several months of continuous operation.

CASE HISTORIES

Bleach Makeup

In recent years, particularly in the pulp mill the old batch system for bleach liquor makeup is being replaced with either semi- or completely automatically controlled systems. Some

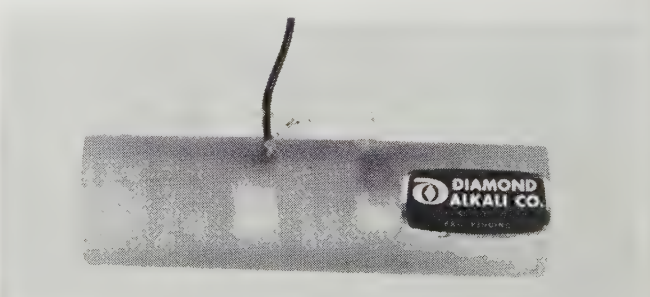

Fig. 2. Flowthrough chlorination cell

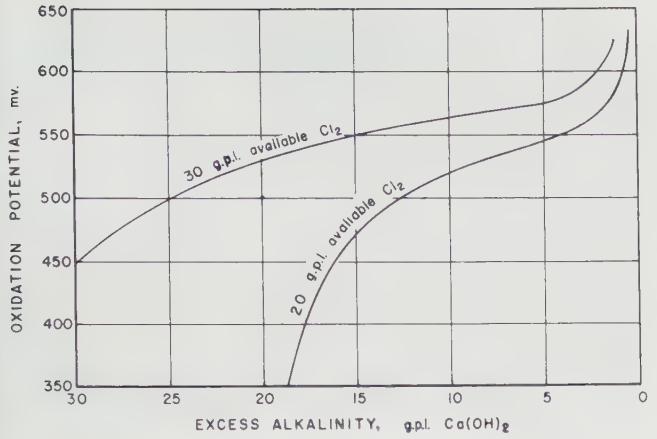

Fig. 3. Calcium hypochlorite bleach solution

of the variables of making bleach liquor by which control is possible are: increase of volume, changes in temperature, pH, and oxidation potential. In our experience, oxidation potential seems to be the most reliable method of control.

Continuous Automatically Controlled System for Making Calcium Hypochlorite (Hammermill Paper Co., Erie, Pa.). The first opportunity to test our cells in making bleach liquor was in the Hammermill Paper Co. when they were engaged in installing an automatically controlled continuous calcium hypochlorite bleach system. This operation uses pebble lime to produce a centrifugally cleaned bleach. The cell which was first used at this mill was an early model of our flowthrough cell. The cell was assembled from several Lucite® component parts clamped together with metal rods. After several months operation, short circuits developed in this cell because of the difficulty involved in sealing lead wires between machined blocks of Lucite. This experience was corrected when the cell was constructed in the present form, developed jointly by Hammermill Paper Co. and Diamond Alkali Co.

Bleach at a concentration of 2.0% available chlorine is used in the mill, with the set point for control at approximately 610 mv. A controlled flow of line slurry is chlorinated with liquid chlorine. Using the flowthrough cell on a bypass flow of the bleach solution, the potential was measured and used to control chlorine addition. In this mill the chlorine control valve is a specially constructed $^3/_4$-in. Hastelloy C valve body with $^1/_4$-in. inner valve.

The Diamond cell was installed and the plant was operated for six months with only routine examination and cleaning of the cell. The original cell was replaced with one of our later models. During the earlier testing period and up to the present time, our cell has given satisfactory results in controlling chlorine addition.

Semicontinuous Calcium Hypochlorite. This bleach makeup system is a batch process for chlorination and a continuous

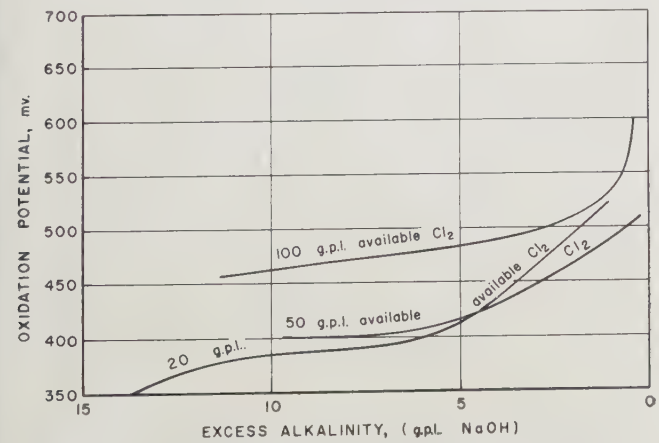

Fig. 4. Sodium hypochlorite bleach solution

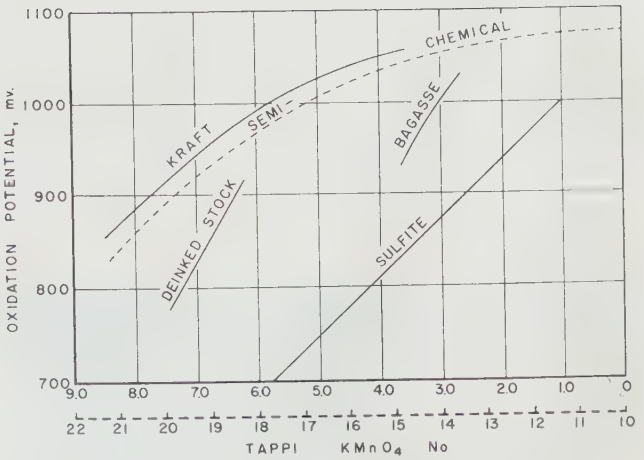

Fig. 5. Laboratory pulp chlorination trials

operation for slaking pebble lime. It is installed in a pulp and paper mill in north central Wisconsin.

For chlorination, lime slurry is fed to one of two 5000-gal. vertical cylindrical tanks that have conical bottons. A centrifugal pump is used to circulate slurry during chlorination. Liquid chlorine is added through a sparging line in the bottom of the tank. Trials have been made using the probe cell mounted at the top of the tank, and with the flowthrough cell in the circulating line.

At the present time, chlorination is not automatically controlled. However, the potential developed at the desired end-point of chlorination is recorded on a Foxboro Dynalog® and used to activate an alarm system.

In this plant the desired concentration of bleach is 30 to 32 g.p.l. available chlorine. However, because of variation in controlling lime-slurry concentration, their finished solutions vary between 32 and 35 g.p.l. available chlorine. At 32 g.p.l. available chlorine, the measured potential is approximately 655 mv. In their present operation this voltage varies ±5 mv. The performance of the cell is excellent and maintenance is low.

Continuous Sodium Hypochlorite (Southern Chemical Cotton Co., Chattanooga, Tenn.). In making sodium hypochlorite bleach, the probe cell has been in continuous service for three months with satisfactory results in the plant of Southern Chemical Cotton Co. The cell has not been cleaned during this time and the millivolt reading has remained the same. Analyses of bleach liquor samples for available chlorine show that the cell is operating properly. Cells (platinum-calomel) used previous to this were cleaned weekly in order to maintain correct readings. These cells had an average life of four months with failure frequency ranging from 1 to 8 months. Performance of the Diamond cell has been most satisfactory.

Pulp Chlorination

Probably the greatest interest to date in the use of our cells has been in mills where programs are underway to install

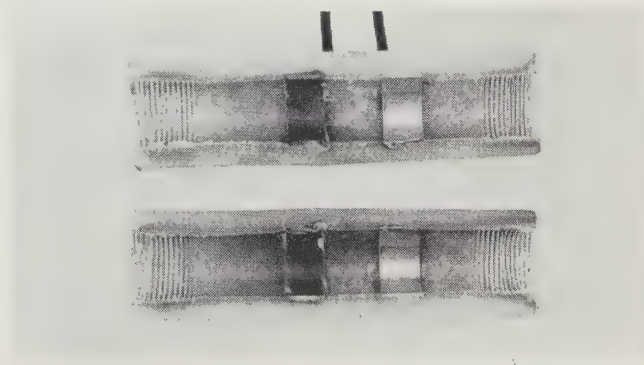

Fig. 6. Cutaway view of flowthrough cell

systems to control the chlorination stage of bleaching. The use of oxidation potential for this control, as you know, has been of general interest of 4 or 5 years. From published reports (*1*, *2*) of oxidation reduction redox potential applications, the potential measured for control purposes was that existing in an especially arranged sample line of chlorinated stock thoroughly mixed and retained for one minute. Several systems have been designed on this principle and the operations are practical and very successful.

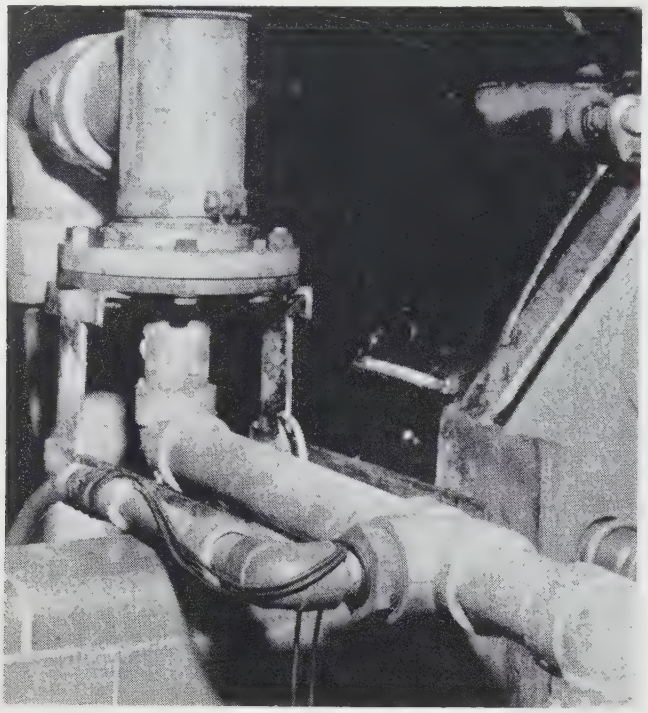

Fig. 7. Flowthrough cell installed at P. H. Glatfelter Co., Spring Grove, Pa.

In the past 18 months, we have worked in several mills that have found it convenient to place the cell for potential measurement directly in the chlorine tower or in stock lines at a convenient point, after approximately 1 min. chlorine retention. This has been easily accomplished because of the design of the probe cell. Some of our experiences from both types of systems are reported for your review:

Control of the Chlorination Stage in Neutral Sulfite Semichemical Pulping (Hammermill Paper Co., Erie, Pa). At the Hammermill Paper Co. the quantity of chlorine used in chlorination is at a comparatively high level. Chlorine is applied in two stages with approximately 80% or the chlorine demand supplied in the first application. In both applications, chlorine gas is admitted to unbleached stock just ahead of an Impco mixer. The chlorinated stock flows up through a preretention vessel that is designed for 4- to 6-min. retention. The probe-type chlorination cell was installed on a standard flange on the side of the vessel at a point approximately 4 min. after the first chlorine application.

When our cell was installed, a potential was recorded on a standard instrument from which manual adjustments of the chlorine gas flow were possible. Improvements in overall pulp cleanliness resulted using redox-potential control. This experience has shown the possibility of fully automatically controlling pulp chlorination at a set point of approximately 1085 mv.

Control of Pulp Chlorination in Mill Producing Kraft (P. H. Glatfelter Co., Spring Grove, Pa.). The data reported in this example were obtained in the P. H. Glatfelter Co., a kraft mill using both pine and hardwood species to produce a wide variety of paper products. The flowthrough model cell has proved to be very satisfactory in automatically controlling pulp chlorination. At the time our cell was first tried in the mill, a redox potential system on chlorination was in operation. The potential is measured on a pulp sample which is pumped through a separate line from the Impco mixer to the headbox of the washer used on chlorinated stock. The sample line is a section of 3-in. Uscolite pipe to a $1^1/_2$ by 1 in. Worthington pump with Duriron impeller. Stock is diluted with water at the pump on the sample line to approximately 1.2% consistency. Approximately 50 ft. of 2-in Uscolite pipe is used to pipe the diluted sample of stock to the headbox of the washer. The flowthrough cell is mounted on a $^3/_4$-in. by-pass line at the washer. The cell installation at the P. H. Glatfelter mill is shown in Fig. 7.

When our cell was first installed, the potential was recorded on a Foxboro Dynalog with a record of operation compared to existing automatically controlled system. Experience justified the replacement of their standard platinum-calomel electrodes with the Diamond cell.

Our cell has now been used for approximately 12 months with only routine inspection and occasional cleaning. During their earlier trials, stock at 3.0 to 3.5% consistency was pumped through the sample line, but now better flow is maintained with consistency below 2%.

In this mill, pine and hardwoods are processed separately through the bleach plant. A three-stage bleach is used: chlorination, hypochlorite, and chlorine dioxide. With redox-potential control on the first bleach stage they are able to maintain bleach demand, after chlorination, of both types of pulp in a narrow and uniform range. In the chlorination of both softwood and hardwood furnish, they reduce the permanganate number to a desired level and good control is obtained.

After washing the chlorinated stock, the pH is adjusted with caustic to maintain uniform in the chlorination stage which is provided with redox-potential this was a difficult operation.

In addition to the system for controlling pulp chlorination, the chlorination cell is being used in the headbox of the hypochlorite washer to indicate an excess of residual bleach as chlorine. At this mill it is desirable to maintain residual bleach as chlorine. At this mill it is desirable to maintain residual bleach as chlorine below a level of 0.1%. With pH maintained within a normal range a given millivolt reading in the hypo-headbox correlates with the desired control of residual bleach. The hypochlorite bleach addition is controlled manually by the operator.

Control of Pulp Chlorination in Mill Producing Kraft and Semichemical Pulp (North Carolina Pulp Co., Plymouth, N.C.). In the North Carolina Pulp Co. mill, our probe-type chlorination cell was used to replace a commercially available platinum-silver cell.

A description of their redox-potential control system is as follows: stock from an unbleached chest is pumped to an Impco mixer. Chlorine is added just ahead of the mixer where gas flow is continuously measured and recorded. The chlorinated stock for redox-potential control is sampled with a 4-in. Uscolite line. Stock at 3.5% consistency is diluted to approximately 1.5% consistency and pumped to an elevated overflow box located above the level of the chlorine tower with overflow from the sample box to the unbleached stock chest. Our probe-type cell is installed in the sample box. The sample line is designed to give approximately $1^1/_2$ to 2 min. chlorine retention prior to redox-potential measurement.

Before our cell was installed, this company experienced the usual problems of erratic and undependable cell life. With the use of our cell they have had very good operation with respect to stock flow around the cell and a very successful cell maintenance program in which polarity is reversed once a day.

Figure 8 shows two charts of a typical days production from this mill. It is very interesting to note that a uniform chlorination is easily obtained with redox-potential control, although,

Fig. 8. Recorder charts from production in The North Carolina Pulp Co., Plymouth, N. C.

because of pulp demand, the chlorine gas flow varies considerably.

Control of Pulp Chlorination in Mill Producing Paper from Bagasse (Valentine Pulp and Paper Co., Lockport, La.). The Valentine Pulp and Paper Co. installed a system to control chlorination 2 or 3 years ago. After only brief experimental testing they were able to control to a very uniform degree of chlorination. Bagasse pulp is chlorinated at approximately 3 to 3.5% consistency. A small Uscolite sample line is installed on the stock line at the base of the chlorine tower. Stock is diluted with water to approximately 1% and pumped to an unbleached stock chest.

At the present time this company has conducted only experimental work using our cells in which a Beckman Model G pH meter has been used to measure oxidation potential. They have obtained some very favorable results and seem to favor the use of the flowthrough cell.

Control of Pulp Chlorination in Mill Producing Kraft Pulp (Packaging Corp. of America, American Box Board Division, Filer City, Mich.). The flowthrough cell was installed in a pulp chlorination controls system on kraft pulp at the American Box Board plant. The type of installation follows the conventional in a small sample line of chlorinated pulp.

This company has reported to us that they are very pleased with the Diamond cell and feel the entire cost of their redox-potential system has been recovered in the first five months of operation owing to the lower use of chlorine.

We have charts from this company representing typical days of operation which point to several advantages gained from their redox-potential system. Under normal conditions of operation in the pulp mill, they have a satisfactory control of the chlorination stage of bleaching. When changing their furnish from pine to hardwood, they record a prompt and distinct drop in the potential of approximately 30 mv.

They also consider advantageous the instantaneous evidence of an interruption in chlorine supply. This they use routinely as a signal to switch chlorine cars.

While we have described, herein, only plant experience using these cells in making bleach and controlling pulp chlorination, we wish to report the application of our cells, in several mills, for use in pH control at the headbox of the machine. We have also obtained some promising results at our Painesville, Ohio, plant measuring reduction potential in an effluent stream from our chromium chemicals operations.

Our experience has proved the Diamond cell to be a practical tool for measuring oxidation potential. Its design provides for a simple installation in a redox-potential system. The materials of construction have demonstrated their ability to withstand mill operating conditions.

LITERATURE CITED

1. Seymour, George W., *Tappi* Vol. 40, No. 6: 426–428 (June, 1957).
2. Bush, W. N., *Pulp and Paper Magazine of Canada*, Convention Number, 197–202 (January, 1958).

RECEIVED March 15, 1960. Presented at the 45th Annual Meeting of the Technical Association of the Pulp and Paper Industry, held in New York, N. Y., Feb. 22–25, 1960.

I wish to acknowledge the assistance of the companies referred to in this paper who cooperated with us in obtaining this information. I also wish to express our appreciation for their permission to report their mill experiences.

Production of Lignin and Organic Acids from Kraft Pulping Black Liquor

M. E. FINDLEY

The purpose of this investigation was to study possible methods of producing organic products from kraft pulping black liquor, and to obtain some idea of the economic feasibility of such a process. Since thiolignin has limited value as is, it was felt that a low cost would be necessary to establish an appreciable market. The data indicate it is possible to use a portion of the black liquor to produce acetic and formic acids and thiolignin with cooking chemical recovery. The processing would include oxidation of the liquor, acidification, filtration, drying, extraction or distillation, possibly furfural production, and conventional cooking chemical recovery, possibly with modification. A comparison of the potential value of the black liquor components under various processing conditions is made. This comparison indicates that a portion of the liquor might provide an increase in value of $0.10 per 100 lb. of the black liquor studied, based on a thiolignin value of $0.02 per lb. On this basis it is felt that a suitable market or utilization of lignin might be developed, and an economic process realized.

IN KRAFT pulping processes, approximately one half of the wood is burned in the recovery furnace as black liquor to reclaim cooking chemical, NaOH and Na_2S. This organic material is utilized in a somewhat inefficient manner since its sole functions are to reduce makeup salt-cake sodium sulfate and organic sulfides to sodium sulfide and to supply heat. The supply of heat is also somewhat inefficient owing to the large amounts of water present. In areas where natural gas is available, it would appear desirable to obtain as much value as possible from processing the organic chemicals present, rather than utilizing their heating value, due to the low cost per B.t.u. and convenience of natural gas.

Thiolignin is a major component of kraft black liquor and may be separated relatively easily, but at present prices the market is limited, and relatively minor amounts of lignin are produced compared to that which could be produced. Numerous articles and patents have been written on uses for lignin. It has been proposed that lignin be used for fuels, lubricants, aromatic acids, resins, wallboard, phenolic chemicals, rubber compounding, carbon, coke, fertilizer, ion exchanger resins, adhesives, oxalic acid production, and for thermosetting resins (*1*). However, most of these products may also be obtained from petroleum or coal by-products which are priced considerably below the cost of lignin under present conditions. As long as this condition holds there seems to be little chance of large-scale lignin production by more than a few paper or pulp companies.

If other chemical products could be produced from black liquor, the price required for lignin or lignin products might be lowered enough to provide a larger market or wider utilization, as well as a profitable operation. Other products obtainable from black liquor include organic acids, carbohydrates, and furfural from pentosan. It was the purpose of this investigation to study some aspects of the production of lignin along with other organic products.

M. E. FINDLEY, Associate Research Professor, Auburn Univ., Auburn, Ala.

THEORETICAL CONSIDERATIONS

In the conventional pulping of wood by the kraft process, lignin, hemicelluloses, wood acids, and many extractives in small amounts are dissolved in the alkaline cooking liquor. During the cook turpentine vapors are drawn off and recovered. Following the cook, the dissolved organics are washed from the pulp, partially evaporated, and tall oil skimmings are skimmed off the liquor. These skimmings in turn are used to produce tall oil. The remainder of the liquor is then burned in a recovery furnace to recover cooking chemicals, NaOH, and Na_2S, from the sodium and sulfur compounds in the liquor and makeup salt-cake. The pulp produced is usually less than 50% of the wood, and the turpentine and tall oil make up a very small fraction of the wood. Thus, approximately 50% of the wood is utilized only in combustion in the recovery furnace. This 50% of the wood contains primarily lignin and hemicelluloses, and also small amounts of wood acids, largely acetic and formic. The lignin in the black liquor has been converted to thiolignin by sulfides of the cooking liquor and is presumably in the form of sodium salts.

The acetic and formic acids are also in the form of sodium salts. The thiolignin may be precipitated by acidification of the black liquor, which at the same time converts the acid salts to the free acids. Acetic and formic acids are volatile and soluble in certain water immiscible organic solvents, so that they may be either distilled off or extracted with a suitable solvent (*2*). Such a process is in use on NSSC* liquors (*3*). The remaining constituents of an acidified liquor after removal of lignin and wood acids would be primarily hemicellulose carbohydrates, inorganic cooking chemicals as salts of the acid used in acidification, and the acidification acid. Some of the carbohydrates would be pentosans which could be utilized to produce furfural. The separation of the remainder of these components would probably be difficult and of doubtful economics.

At present, to the writer's knowledge, kraft liquors are not used to produce acetic and formic acids due to the large amounts of acid required to acidify the alkaline black liquor. In addition, the production of thiolignin from kraft liquors is apparently limited by the demand at present prices.

If thiolignin and organic acids, and possibly furfural and, or, other chemicals could be produced, then the costs of production would be born by two or more products. Even so, in order to be economical it would probably be necessary to recover the cooking chemicals involved in such liquors. The methods used in this study followed the above considerations.

PROCEDURE

The black liquor used in this study was received from the International Paper Co. at Mobile, Ala. It was considered to be almost typical of southern kraft black liquors. While the tall oil skimmings had not been removed, a considerable portion of it had risen to the surface, and care was taken to obtain samples free of these skimmings.

The liquor was analyzed for total solids, sulfated ash, and total sulfur according to TAPPI Standard T 625 m-48. The organic matter was calculated in the manner suggested in this standard. Since this organic matter figure consists of the total solids minus the sulfated ash calculated as NaOH, it must include all the sulfur in the liquor. Therefore, the total sulfur in the liquor was subtracted from the organic matter to obtain sulfur free organics. This should be the total organic material originating in the wood.

The liquor was titrated as received with standard acid using a pH meter in order to determine the acid requirements for neutralization and acidification. The pH values of 8 and 4 were chosen because it was felt that a pH of 4 would have to be reached to liberate acetic and formic acids, and precipitation commenced slightly below a pH of 8.

One method of reducing the acid requirement for acidification would be to extract as much wood acids from the wood chips as possible with black liquor prior to cooking the chips and prior to acidification of the black liquor. To estimate acid needs under such conditions, a weighed amount of pine sawdust was refluxed with a measured volume of black liquor for 15 min., and the reduction in acid requirement per unit weight of wood was measured by titration after filtering off the sawdust. This figure was then used to calculate the reduction in acid consumption based on a weight of wood equivalent to that from which the liquor was produced assuming a 50% pulp yield. This amount was subtracted from item 7 to give item 8 in Table I.

The amount of precipitable solids, primarily thiolignin, was determined by acidification with excess sulfuric acid, heating to boiling, but not boiling, to cause the particles to coagulate, filtering, which was accomplished without difficulty, and washing. The precipitate was then oven dried and weighed.

To determine volatile acids excess sulfuric acid was used to acidify 50 ml. of black liquor. After filtering and washing the lignin, the filtrate and washings were distilled down to about 50 ml. At this point water was added through a separatory funnel at the same rate as the vapors distilled. The condensate was caught in a flask and periodically titrated with standard NaOH until the amount of acid distilled over became essentially constant. Barium chloride solution was added to the neutral solution to determine whether any H_2SO_4 or SO_2 had gotten into the distillate. If so, the procedure was re-run.

The results of all the above tests on the original liquor are shown in Table I.

It was expected that oxidation of the black liquor might liberate or form additional acids over that obtainable from the original black liquor. This was found to be true on a preliminary test, and consequently a large sample was oxidized for further testing.

The oxidation procedure was carried out in an autoclave on 1 liter of dilute black liquor. The autoclave was heated to 128°C. in about 1 hr. and held at this temperature for 1 hr. A compressed air pressure of 110 to 130 p.s.i.g. was applied to the autoclave before heating, and five times during the oxidation noncondensable gases were vented and fresh compressed air was applied in order to prevent the depletion of oxygen. The air was simply admitted above the surface of the liquor, so all absorption of oxygen occurred at the liquor surface. In a preliminary test liquor was oxidized at atmospheric pressure in a boiling-water bath by bubbling air through it for about 4 hr. In both cases the amount of volatile acids was essentially the same, but in the preliminary test the effect of evaporation was unknown. In both cases a small amount of cobalt was added as a possible oxidation catalyst (0.4 g. $CoNO_3 \cdot 6H_2O$/l.). However, whether this had any effect is unknown.

Table I. Characteristics of Original Dilute Black Liquor

	Component	*Original liquor,[a] % by wt.*
1.	Total solids	12.54
2.	Sulfated ash, as NaOH	4.11
3.	Organic matter, 1–2	8.43
4.	Total sulfur	0.57
5.	Sulfur-free organics, 3–4	7.86
6.	H_2SO_4 required to neutralize to pH 8	2.06
7.	H_2SO_4 required to acidify to pH 4	3.63
8.	Estimated H_2SO_4 required to acidify to pH 4 if black liquor used to pre-extract wood chips	2.6
9.	Acid-pptd. solids, thiolignin	3.8
10.	Volatile acids after excess acidification, as acetic	1.02

[a] Sp. gr. = 1.067.

* Neutral sulfite semichemical.

Table II. Characteristics of Oxidized Dilute Black Liquor

1.	Total solids	12.97% by weight of oxidized liquor, sp. gr. = 1.068
2.	Lb. oxidized liquor per lb. original liquor	$= \frac{12.54}{12.97} = 0.97$
3.	H_2SO_4 required to neutralize to pH 8	1.40% by wt. basis original liquor
4.	H_2SO_4 required to neutralize to pH 4	3.14% by wt. basis original liquor
5.	Acid-pptd. solids, thiolignin	3.8% by wt. basis original liquor
6.	Volatile acids after excess acidification, as acetic	1.15% by wt. basis original liquor

Table II shows the analyses made on this oxidized liquor. To determine the effect of any evaporation which might have occurred, the weight of total solids was assumed to have remained constant, and the ratio of oxidized liquor to original liquor was calculated on this basis of the original liquor. Table III gives results obtained on the precipitated solids and on various acidified liquors. Total sulfur and sulfated ash were determined in essentially the same manner as used on the liquors.

The H_2S or SO_2 liberated was determined by placing the liquor sample in a distillation flask in a boiling water bath and adding an excess of acid, dropwise, through a separatory funnel. The side tube was connected to a condenser and to bubbling flasks containing a standard amount of I_2. After all the acid had been added, a small amount of air was forced through the system and the I_2 solution. The I_2 was back titrated with thiosulfate. It confirmed indications by smell that oxidation essentially eliminated the evolution of H_2S.

The volatile acids yields determinations were made in a manner similar to those given in the first two tables except that limited amounts of H_2SO_4 were used to obtain some idea of the minimum acid requirements.

Ether extractable acids were determined by dividing the acidified liquor filtrate and washings from 50 ml. of liquor into four equal parts. These were consecutively extracted with 50-ml. portions of ether until no further acid was obtained. A 10-ml. portion of water was used as a wash for all ether portions; fourteen extractions were required. With a concentrated liquor and more efficient washing, the number of extractions could have been reduced appreciably.

The acid soluble nonvolatile organics in the acidified liquor were determined by oxidation with acid dichromate of the residue after a volatile acid distillation. The method used was essentially that given in TAPPI Standard T 203 m-58 for gamma-cellulose with the exception that the acidic solution was diluted to give similar amounts of organics as would be present using the standard on pulp. The organics determined in this way, primarily carbohydrates, were calculated as glucose. It is possible that this figure includes the oxidation of a slight amount of organic sulfur, but not H_2S or SO_2.

To obtain an approximation of the amount of furfural obtainable from the liquor, tests similar to TAPPI Standard T 223 m 58 for pentosans were run on both the acid distillate and the distillation residue from oxidized liquor. The distillation residue was tested according to the volumetric method of the Standard, except for quantities. Since there was a good possibility of furfural being produced during the volatile acids determination, this procedure was carried out without titration, using 5% (of the original liquor) H_2SO_4. The distillate containing volatile acids was acidified with concentrated HCl and analyzed similarly to the distillate in the pentosan standard. The results were expressed as furfural rather than pentosans. These results might be slightly high due to the possibility of other reducing compounds. In neither case was correction made for hydroxymethylfurfural.

To recover the cooking chemicals in an acidified liquor residue, it would probably be necessary to mix the acidic residue with sufficient black liquor to carry out the necessary combustion and reduction. In order to do this, it would be necessary to mix it with enough liquor to prevent precipitation of the black liquor solids, or else use the sodium carbonate and sodium sulfide of green liquor or NaOH and Na_2S of white liquor to neutralize the acid. For this reason the amount of sodium hydroxide necessary to neutralize the distillation residue was calculated. The quantity of black liquor required to neutralize the acid was also calculated. This was done by subtracting, from the total amount of acid added, the amount of acid required to reach pH of 8, and also the equivalent of the volatile acids removed, thus giving the amount of acid to neutralize to reach a pH of 8. This was converted to NaOH required and also to liquor required based on its alkalinity above pH 8. The results of these calculations are given in Table IV.

Table III. Characteristics of Solids and Liquors from Acid Precipitation of Dilute Black Liquors

1 Item	*2 Original dilute black liquor, % by wt.*	*3 Oxidized dilute black liquor, % by wt. of 2*
Total sulfur in pptd. solids	0.16	0.17
Sulfated ash in pptd. solids, as NaOH	...	0.10
H_2S or SO_2 liberated on acidification, as S	0.037	0.0075
Distillable acids from liquor acidified with 5.0% H_2SO_4 by wt., as acetic	1.02	1.09
Distillable acids obtained from liquor acidified with 4.1% H_2SO_4 by wt., as acetic	...	0.95
Distillable acids obtained from liquor acidified with 3.2% H_2SO_4 by wt., as acetic	...	0.53
Ether-extractable acids from liquor acidified with 5% H_2SO_4 by wt., as acetic	0.94	...
Acid soluble, nonvolatile organics in acidified liquor residue, as glucose	1.61	1.68
Furfural in acid distillate from liquor acidified with 5% H_2SO_4	...	0.11
Furfural obtainable from acidified (5%) liquor residue	...	0.088

Also given in Table IV is a figure for an amount of sulfide, or possibly sulfite, which was obtained on combustion of the acid distillation residue. This figure was obtained by neutralizing the acid residue with NaOH, drying and heating the residue in a partially covered crucible over a Bunsen burner until combustion took place, dissolving the smelt produced in a volumetric flask, and analyzing according to TAPPI Standard T 624 m-44 for sulfide, sulfite, and thiosulfate.

Table V gives the calculated potential value of the black liquor studied under certain assumed conditions. Chemical costs were obtained from *Chemical & Engineering News* (June 29, 1959) and *Oil, Paint, and Drug Reporter* (Hi-Lo-Chemical Price Issue) (Feb. 25, 1959). The value of the black liquor heating value was determined as the cost of natural gas to replace the heat from the liquor. For natural gas a value of 35¢ per 1000 cu. ft. at 1000 B.t.u. per cu. ft. was used, and it was assumed the liquor had a heating value of 6610 B.t.u. per lb. black liquor solids. The figures correspond to the black liquor heating value used in (*4*), and the approximate cost of natural gas to Alabama Polytechnic Institute. In the first column of Table V, the value of the liquor is based on replacing the cooking chemicals with NaOH and Na_2S in the proportions indicated in the analysis. In the second column the value is based on replacing the sodium and sulfide with equivalent amounts of Na_2SO_4 in saltcake, and Na_2CO_3 which in the conventional recovery system would be converted to Na_2S and NaOH. The third and fourth columns are based on the values of volatile acids as acetic (since this gives a smaller value than formic) minus the cost

Table IV. Factors Affecting Recovery of Cooking Chemicals Following a Volatile Acid–Lignin Recovery Process

Basis 100 lb. of original liquor acidified with 5% H_2SO_4

NaOH required to alkalize distillation residue from original liquor to pH 8	1.72 lb.
Black liquor required to alkalize distillation residue from original liquor to pH 8	102 lb.
NaOH required to alkalize distillation residue from oxidized liquor to pH 8	2.21 lb.
Original black liquor required to alkalize distillation residue from oxidized liquor	132 lb.
Sulfide obtainable on combustion of NaOH neutralized distillation residue	at least 0.44 lb.

of H_2SO_4 necessary for acidification. The value of the cooking chemical was figured as the value in the second column minus the cost of Na_2CO_3 to replace the sodium lost in the solids. Sulfur would be more than replaced by H_2SO_4.

DISCUSSION OF RESULTS

In considering a process to produce lignin and organic acids from kraft black liquor, an important factor would be the relationship between the amount of acid required to acidify the liquor, and the amount of acids produced, as well as the relative costs of the two acids. Table I indicates that assuming a pH of 4, the requirement of sulfuric acid is about four times the amount of volatile acids (as acetic) produced. It would be desirable, if possible, to reduce the amount of acid required in acidification of the black liquor.

One possibility of reducing acid requirement may be to use slightly less cooking liquor (or a lower concentration) and cook to a lower residual alkalinity in the black liquor, but this would increase the cooking time of the wood beyond normal. However, if any wood acids could be extracted from the chips before cooking by the black liquor (see Fig. 1), this would both neutralize some of the liquor alkalinity and reduce the concentration, or amount, of liquor required in the cook. An estimate of the effect of such a procedure is given in item 8 of Table I. This is no more than an estimate, since sawdust, which was somewhat aged, was used to simulate chips. Chips would be less effective due to size, and in addition some sodium ions were probably absorbed by the cellulose. On a steady recycle basis the sodium ions adsorbed would return in the black liquor. The reduction in H_2SO_4 required was more than the equivalent amount of volatile acids in the liquor, and thus probably not a true picture. However, the figure does give some indication that appreciable amounts of wood acids might be extractable in this way.

The results given in Table II indicate the difference which might be expected on using an oxidized liquor. Item 2 is based on the assumption that the oxidized liquor contains the same amount of total solids as the original liquor. This assumption could be somewhat in error due to the reaction with oxygen, but is probably approximately correct. The remaining values are calculated on the basis of the original liquor. The indications are that less acid would be required for acidification, and more volatile acids could be produced

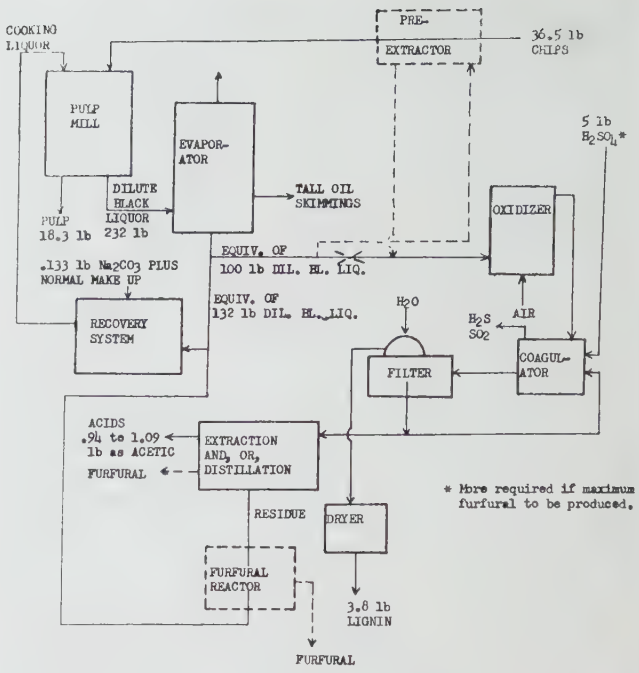

Fig. 1. Proposed process

Basis: 100 lb. dilute black liquor to organics production.

with an oxidized liquor. It is apparent that the increase in volatile acids is not sufficient to cause the reduction in acid requirement, and therefore, other acidic groups must have been produced in the liquor, probably from sulfide groups. An additional advantage of oxidizing the liquor prior to production of acetic acid and thiolignin appeared to be a decrease in the amount of free sulfur formed on acidification and heating, thus reducing the likelihood of equipment fouling in a commercial operation. If an oxidized liquor were utilized for these purposes, it would mean that an oxidized thiolignin would be produced, which would undoubtedly have somewhat different properties than thiolignin. For most purposes, however, it would probably have similar properties.

The data on distillable acids as a function of acid used in acidification given in Table III indicate that somewhat more acid than that required to reach pH 4 is necessary to obtain an appreciable amount of volatile acids. Also, it appears that the difference between oxidized liquor and the original liquor is not so great when a limited amount of H_2SO_4 is added. However, this advantage remains, and, in addition, Table III shows that the H_2S or SO_2 liberated on acidification would be less with the oxidized liquor. Thus in any process such as this the advantages of increased acid production, less H_2S evolution, and less free sulfur formation, would need to be evaluated against the extra oxidation step and the possible disadvantage of producing an oxidized lignin.

It is apparent from the ether extractable acid content that

Table V. Material Value of Black Liquor Components under Various Processing Assumptions

Basis 100 lb. dilute black liquor acidified with 5% H_2SO_4

A *Replacement value if no recovery carried out*	*B* *Value if replaced by saltcake and Na_2CO_3 to recovery furnace*	*C* *Value of organic products and residue to recovery from original liquor*	*D* *Value of organic products and residue to recovery from oxidized liquor*
NaOH at 3.8¢/lb. = 0.102	Saltcake at 1.4¢/lb. Na_2SO_4 = 0.036	Acetic acid at 10¢/lb. = 0.102	Acetic acid = 0.108
Na_2S at 5.5¢/lb. = 0.077	Na_2CO_3 at 1.8¢/lb. = 0.064	Minus H_2SO_4 at 1¢/lb. = −0.050	Minus H_2SO_4 = −0.048
Heating value replacement at 35¢/1000 cu. ft. natural gas = 0.029	Heating value = 0.029	Inorganics = 0.100 Minus Na_2CO_3 makeup Lignin loss = −0.004 Thiolignin = 3.8x	Inorganics = 0.100 Minus Na_2CO_3 = −0.004 Oxidized thiolignin = 3.8y
Total $0.208	$0.129	$0.148 + 3.8$x$	$0.156 + 3.8$y$

Note: x, y = Value per lb. of lignin.

this extraction would produce less acids than distillation. This may also indicate that about 8% of the acids available from the liquor are not acetic and formic acids or ether soluble acids. It is possible that this 8% of the acids might be such acids as oxalic or other organic acids, which are somewhat volatile, but with a high water to ether partition coefficient.

The amount of volatile acids produced might appear to be somewhat high compared to the acetyl and formyl content of softwoods. Assuming 50% of the wood is dissolved in the liquor studied, the original weight of the wood would have been 15.72 lb./100 lb. liquor, and the acetic acid produced (Table I) would be 6.5% of the wood, considerably higher than normal acetyl content of softwoods. However, it has been shown (*5*) that in alkaline cooking volatile acids produced can be greater than the acetyl content of the wood, to as high as 7% for loblolly pine. Thus the amount of volatile acids is in the range which might be expected.

Another possible product shown in Table III would be furfural, but the amounts would be dependent on the wood, type of cook, and the amount of pentosans removed from the wood. If organic acids were distilled off the acidified liquor, some furfural would be produced which could be separated by extraction and, or, distillation without carrying out a separate reaction. Pentosans in the distillation residue require additional acid and processing to produce furfural.

At this point, it is possible to visualize a possible process to produce acetic and formic acids and oxidized lignin. Such a process is shown in Fig. 1. The black liquor from storage would be partially concentrated by evaporation and the tall oil skimmings would be drawn off. The liquor could then be split into two streams, one being sent to an oxidation reactor and the other to further evaporation and the recovery furnace. The oxidized liquor would then be acidified, filtered, and washed. The lignin would be dried and the filtrate and washings could be either extracted or distilled to produce volatile acids. As mentioned earlier, a pre-extraction of chips could be included to advantage, and it might be feasible to produce furfural.

To recover the cooking chemical and dispose of the carbohydrates, the distillation residue could be sent to the recovery furnace along with the required amount of unprocessed black liquor to produce a pH of 8. Table IV gives the amount of liquor which would be required to neutralize the acid residue.

A pre-extraction of wood chips was mentioned previously as a method of reducing the sulfuric acid requirement. An additional advantage might be that an appreciable portion of the wood acids present in the chips could be extracted by the liquor to be processed for organics. In this way the wood acids in the black liquor not processed would be reduced, and the acids obtainable in the processing would be increased, probably to an appreciable extent.

There might be some question in such a process as to whether there would be sufficient organics going to the recovery furnace to reduce the cooking chemicals to the sulfide. From Table III it can be seen that in the acid residue from 100 lb. of liquor there is approximately 1.6 to 1.7 lb. of oxidizable organics remaining (expressed as glucose). The results of a combustion test shown in Table IV show that at least 0.44 lb. of sulfide (as sulfur) can be produced from the acid residue alone, whereas only 0.57 lb. existed in the original liquor. Since the reducing conditions were uncontrollable with the equipment used, this test may not represent the recovery system at all, and may be no where near the maximum sulfide producible. Thus the organics of the unprocessed black liquor would probably be more than sufficient to supply the necessary reducing power.

There would likely be a problem of controlling the composition of the cooking liquor and preventing the buildup sulfate or sulfide. A crystallization or precipitation system might be required somewhere in the system, even though much of the excess sulfur would probably leave as SO_2 in the furnace. Such a crystallization process could be similar to the one used in the Western Precipitation Corp. sodium-base sulfite recovery process (*6*).

While a complete economic evaluation is impossible at this stage, it is of interest to compare the potential value of the black liquor under various assumed conditions. Column A of Table V lists the value of black liquor if its sulfur content were replaced with Na_2S and the remainder of the sodium were replaced with NaOH. This \$0.21 would be the loss per 100 lb. of liquor if no recovery operations were carried out. However, if a recovery system were maintained and a portion of the liquor were replaced with salt cake and soda ash to produce cooking chemical in the recovery system, and with natural gas to replace heating value, the value of the replaced portion would be given by column B. This is considerably less than column A, and represents a more probable condition. Thus if a limited portion of the black liquor were used to produce organics, its value would be about \$0.13 per 100 lb.

Column C includes the value of the lignin and volatile acids in the unoxidized liquor minus the cost of sulfuric acid required. This does not consider the effects of pre-extraction of chips. In addition, it includes the value of the cooking chemical (as in B) minus the value of the sodium lost in the lignin solids, if replaced by sodium carbonate. Since a large-scale market for lignin would not be available at the present prices of about 7 to 8¢ per lb. (*7*), the value of thiolignin was left x, an unknown. Thus the value of the liquor would increase in such a system from \$0.13 to \$0.15 plus 3.8 x. A large market would probably be available only when the value of lignin was in the neighborhood of coal tar and asphalt, or somewhere around 2¢ per lb. Thus the total value might be around \$0.22 per 100 lb. of liquor. The same considerations hold for column D where oxidized liquor is used and y is assumed to represent oxidized lignin value. Total potential product value under such conditions might increase about 1¢ per 100 lb. to about \$0.23, or about 10¢ above the value of the feed under the assumptions made.

Furfural from the acid distillate only at 12¢ per lb. might provide an additional product value of 1¢ per 100 lb. of the liquor studied. A total furfural product value of 2¢ might be obtained, if an additional reaction and the use of additional acid were feasible. On this particular liquor it might be worth while to isolate the furfural from an acid distillate, but production of furfural from the acid residue appears to be of doubtful economics.

It is apparent from Table V that one of the greatest values of the liquor is in the form of NaOH and Na_2S after recovery. If no cooking chemical recovery were made, the value of the organics produced would have to exceed 21¢ per 100 lb. liquor. Assuming the acids have a value of 6¢, the value of the thiolignin would have to be greater than 15¢, or 4¢ per lb., to be considered. Thus no process such as suggested would be advisable without a recovery furnace or other method of reclaiming cooking chemicals, unless a suitable lignin market existed at over 4¢ per lb.

Another possibility is shown by the increased value of the liquor in column A over column B. This indicates that if additional Na_2SO_4 could be added to the black liquor and converted to Na_2S in the recovery furnace, and if this could be separated and sold, it could be a profitable operation. In addition, the possibility exists that the H_2SO_4 fed into an organics recovery system might be converted into a more valuable product such as Na_2S, by neutralizing with Na_2CO_3 and producing Na_2S in the recovery furnace.

In addition to the components investigated in this study, it is apparent that other components are present which are unaccounted for. Of 7.86 lb. of sulfur free organics present in 100 lb. of original liquor, oxidized lignin accounts for 3.8 lb., acids approximately 1.15 lb., furfural in acid distillate

0.11 lb., and carbohydrates approximately 1.68 lb. Thus a total of about 6.74 lb. has some known characteristics, and this leaves about 1.12 lb. of unknown nature, and most of this probably was distilled off, or was miscalculated as glucose in the distillation residue. Based on some knowledge of the constituents of wood this unknown portion might be methyl alcohol from lignin hydrolysis and various wood extractives. In the suggested process it might be economical to separate these components by distillation, extraction, etc., as additional products.

The amount of pulp produced corresponding to this liquor would be about 7½ lb. per 100 lb. of liquor, and would probably be worth 75¢ or less. The potential increase in value of the components in part of the liquor using the suggested process or equivalent might be 10¢ per 100 lb. liquor processed. If the complete wood handling, chipping, cooking, bleaching, sheet forming, drying, and recovery operations can be carried out for a 75¢ product, it would appear that it might well be worth the additional facilities to produce an extra 10¢ of value on a portion of the liquor.

While definite predictions cannot be made as to the economies of the suggested process, the results point to the definite possibility that the recovery of organic materials from black liquor is feasible, if not promising.

CONCLUSIONS

As a result of this study it seems reasonable to derive the following conclusions:

1. The processing of a portion of the black liquor from a pulp mill to yield thiolignin and organic acids appears to be economically feasible and worthy of continued investigation.
2. The use of the black liquor from a pulp mill to produce thiolignin and acetic acid only without recovery of cooking chemicals would probably be much less favorable economically.
3. Oxidation of the black liquor prior to organic acid and lignin production would probably produce operating and economic advantages including an increase in organic acid yield.
4. Further study of the suggested process as to operating conditions, operating costs, and equipment requirements should be made, especially on the recovery furnace, to more thoroughly define the economics.
5. In addition to the foregoing, a study to determine other possible organic and inorganic products would appear to be worth while.

LITERATURE CITED

1. Pearl, I. A., *For. Prod. J.* No. 12: 427–432 (Dec., 1957).
2. Katzen, R., Aries, R. S., and Othmer, D. F., *Ind. Eng. Chem.* 37, 442 (1945).
3. Copenhaver, J. E., Biggs, W. A., Jr., and Baxley, W. A., U. S. patents 2,744,927 (May 8, 1956) and 2,714,118 (July 26, 1955).
4. Stephenson, J. N., Ed., "Preparation and Treatment of Wood Pulp," N. Y., McGraw-Hill, 1950.
5. Wise, L. E. and Jahn, E. C., "Wood Chemistry," 2nd ed., N. Y., Reinhold Publ. Co., 1952, vol. II, p. 996.
6. Parsons, S. R. and Boyer, R. Q., *Tappi* 42, No. 7, 559 (July, 1959).
7. Price Schedule, Polychemicals Div., W. Va. Pulp & Paper, April 1, 1959.

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A Review of the Continuous Production of Hypochlorites in the Paper Industry

I. C. MACGUGAN and R. S. ERICSON

The continuous manufacture of hypochlorite solutions as recommended for use in the pulp and paper industry is reviewed. One system for producing sodium hypochlorite solution continuously is discussed in detail. The advantages to be obtained by the use of a continuous system as contrasted to the batch system are uniformity of product, reduction in operating space requirements, and reduced labor costs.

The recent trend in the pulp and paper industry has been toward more and more automation, particularly in the numerous chemical preparation and feed systems so widely used in the various mill processes. This trend has been due to a desire for closer control of processes and a need to decrease chemical and operating costs. Resulting economics in overall production generally warrant the establishment of such systems.

Hypochlorite solutions, both sodium and calcium, lend themselves very well to automatic control owing to the relatively simple chemical reactions involved. The preparation of bleach liquor from either sodium hydroxide or calcium hydroxide involves the following equations:

$$2\ NaOH + Cl_2 \rightarrow NaOCl + NaCl + H_2O$$

$$2\ Ca(OH)_2 + 2\ Cl_2 \rightarrow Ca(OCl)_2 + CaCl_2 + 2\ H_2O$$

Since both these reactions are exothermic and since high temperatures favor the production of chlorate ions over hypochlorite ions, it has been found desirable, particularly in producing high concentration solutions, to maintain the reaction at less than 86°F. for sodium and not greater than 104°F. for calcium hypochlorite.

The relatively simple nature of these reactions make them ideal for electrometric control either by pH or oxidation-reduction (redox) potential methods. The neutralization of the alkali with chlorine exhibits a marked pH inflection end point which can be used for control. Owing to the lower cost, simple electrode system, and more instantaneous response as compared to pH, the control based on redox is to

I. C. MacGugan, Section Head, Pulp & Paper Section, Industrial Applications, Research Division, Wyandotte Chemicals Corp., Wyandotte, Mich., and R. S. Ericson, Jr., Assistant Manager, Michigan Alkali Division Technical Sales & Service Dept., Wyandotte Chemicals Corp., Wyandotte, Mich.

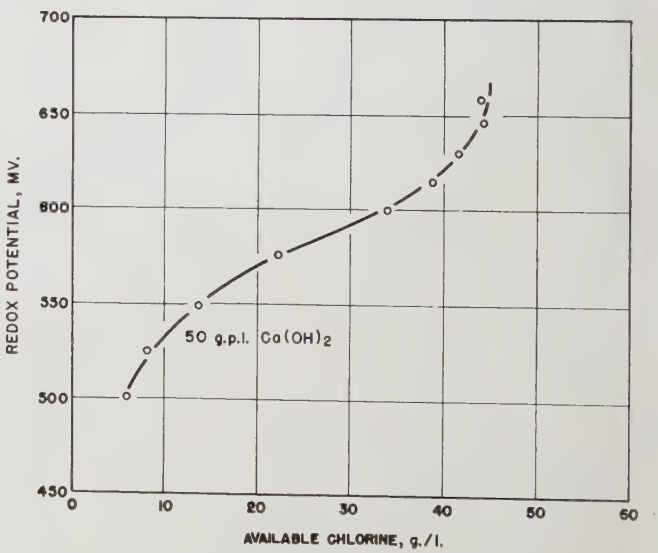

Fig. 1. Redox potential as a function of available chlorine concentration platinum-silver electrodes

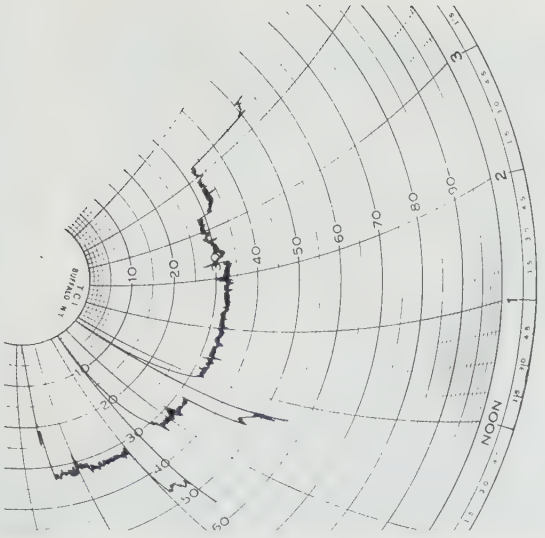

Fig. 2. Control chart for 50 g.p.l. soda bleach

be preferred. Continuous control in the production of hypochlorite solutions is based on the principle that two dissimilar metal electrodes, such as platinum and silver, when immersed in a hypochlorite solution, generate a small electrical potential. This voltage will change as chlorine is added to the alkaline solution and will rise rapidly as the neutralization point is approached. While the potential values will vary according to solution strengths, in each separate case they are reproducible. Therefore, in a typical mill installation, once the initial values are established, the automatic control of the hypochlorite manufacture can be closely controlled.

Figure 1 shows a representative curve obtained by plotting redox potential as millivolts against the concentration of available chlorine in grams per liter. In manufacturing calcium hypochlorite any lime concentration, over a certain minimum, can be used to prepare a bleach containing the desired available chlorine and excess alkalinity. In such cases, the excess alkalinity would be 1.5 g.p.l. and any unreacted calcium hydroxide would be removed by settling.

When a soda bleach is desired with a specified available chlorine concentration and excess alkalinity, then there is only one possible feed caustic concentration permissible.

The automatic control is effected by using the voltage generated to actuate measuring and control equipment which will automatically meter the chlorine addition to the alkali solution and maintain a continuous record of the potential generated.

Figure 2 is a photograph of a typical flow chart as used in the continuous manufacture of sodium hypochlorite. As may be noted, the signal indication is excellent and shows that an extremely uniform product is being produced. Reproducibility of the product is also good, as is shown by the return of the signal indication to its original level following a shutdown period.

Control by redox potential is dependent to a large degree on the type of electrodes together with their position and orientation in the process. An important point to be noted is the positioning of the control electrodes as they should be located close enough to the reaction so that no excessive lag in chlorine feed can be introduced.

Basically, then, a continuous automatic hypochlorite process consists of feeding an alkaline solution of controlled strength through a reactor into which chlorine is fed, with thorough mixing. The hypochlorite solution formed is passed over measuring electrodes which determine the excess alkali present and which cause a flow control valve to admit chlorine, as needed.

Either liquid or gaseous chlorine can be used, however, control is more accurate with gaseous chlorine and thus the latter is preferred and recommended. The process is inherently flexible since sodium hypochlorite solutions of from 30 to 50 g.p.l. of available chlorine can be produced in the same system.

The continuous production of hypochlorite solution possesses several advantages over a batch makeup system. These advantages are: reduction in manpower required, reduction in operating and/or production space required, more uniform product, elimination of decomposition through overchlorination, elimination of needless excess alkali with resultant chemical savings, and elimination of large storage systems with attendant decomposition losses.

The majority of the systems for the continuous manufacture of hypochlorite bleach solutions use redox potential measurements for control purposes. Some of the systems available to the pulp and paper industry for this purpose are patented, others are not.

Essentially such a system would consist of a means for vaporizing liquid chlorine and feeding it to a reaction column. Similarly a dilute solution of known concentration of alkali (either of caustic soda or lime), is prepared and metered to the same column. Mixing of the two chemicals is generally accomplished by means of a mixing eductor located ahead of the reaction column, or by means of a draft tube located in the base of the reaction column. While the reaction between chlorine and an alkali is autocatalytic in nature, it is relatively fast after the initial induction period, and the reaction can be considered complete prior to the solution passing from the reaction column. The redox potential electrodes governing the chlorine flow are located at a sufficient distance from the mixing zone in order to insure that complete reaction has occurred. Such a system may be generally modified to produce lime bleach by the installation of centrifugal separators or settling tanks in order to separate the unreacted lime particles prior to storage and use.

A more specific and detailed description of a system designed for the continuous manufacture of hypochlorite is presented by describing the process developed by Wyandotte Chemicals Corp. This system for producing sodium hypochlorite solutions of up to 50 g.p.l. available chlorine is depicted schematically in Fig. 3.

In this system for the production of sodium hypochlorite, the dilute caustic soda solution is prepared generally from commercial 50% caustic soda. This is done by means of a ratio-flow controller, which allows the delivery of predetermined amounts of water and caustic soda. In addition to the ratio-flow controller a liquid-level controller in the bleach-liquor storage tank controls the flow of caustic to the system. A redox potential recorder controller is used to meter the chlorine flow, depending upon the available chlorine concentration wanted in the finished bleach.

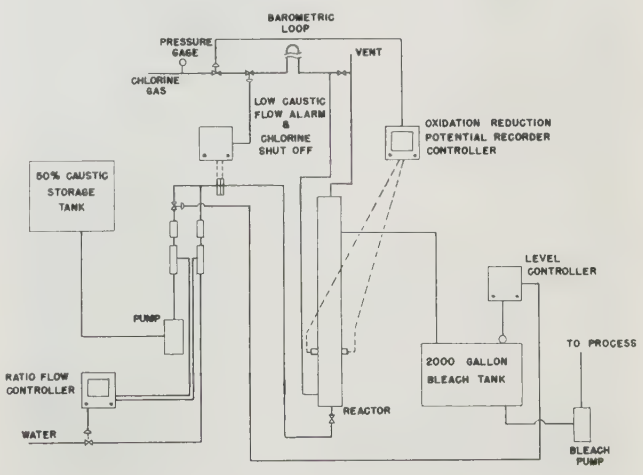

Fig. 3. Continuous reactor system for the production of soda bleach

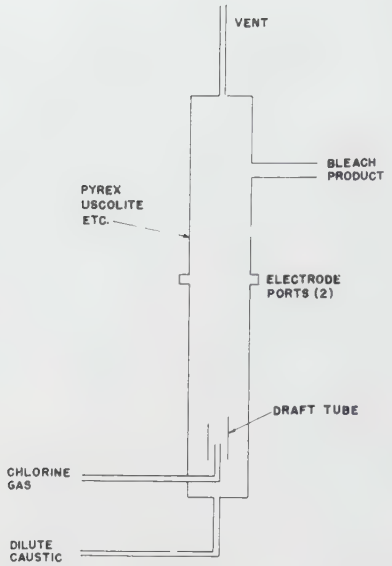

Fig. 4. Single pass concurrent flow reactor

The dilute caustic solution is pumped through a low caustic-flow alarm and chlorine-shutoff recorder and into the base of the reactor column. The gaseous chlorine is led into the base of the draft tube. Excellent internal mixing is obtained using this draft tube, which is shown in detail in Fig. 4.

The reacted material flows out of the top of the reactor column to the hypochlorite storage tank. The redox potential electrodes are inserted into the reactor column at a sufficient distance above the draft tube so that complete reaction has taken place prior to the measurement being made. The reacted hypochlorite flows to a storage tank which is fitted with a liquid-level controller actuating the caustic flow. The redox potential electrodes actuate a recorder-controller which meters the flow of chlorine to the reactor tube. The chlorine flow is adjusted to predetermined millivolt values to obtain the required available chlorine and excess caustic concentrations.

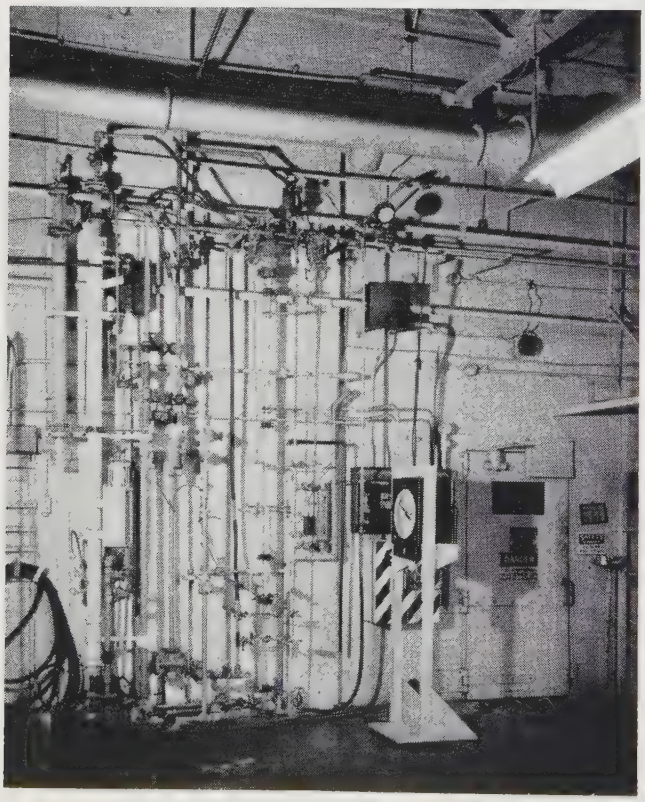

Fig. 5

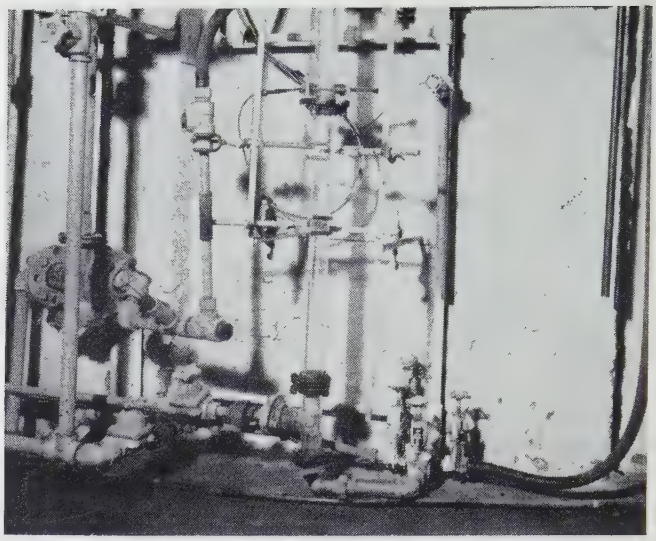

Fig. 6

The process is designed to be "fail-safe." For those instances, when, for any reason, the dilute caustic flow decreases below a predetermined minimum, the caustic-flow alarm and chlorine-shutoff valve will immediately shut off the chlorine flow. This insures against loss of chlorine if the dilute caustic flow stops. Low and high alarms can also be installed on the redox potential recorder to notify the operator if the bleach strength is not within set limits.

The production of calcium hypochlorite with this system requires little additional equipment. Screened lime slurry is used in place of caustic soda. Prior to entering storage the reacted calcium hypochlorite is pumped through centrifugal settlers which separate the unreacted lime from the solution. This lime sludge may be returned to the lime makeup tank.

A typical, single pass, continuous hypochlorite unit is shown in Fig. 5. As may be noted from the figure the unit is compact and occupies a mill area. Figure 6 gives a close-up of the reactor column. These units are capable of producing 3000 gal. per day of 50 g.p.l. sodium hypochlorite.

Beside the chemical economy and more uniform product produced by the continuous system, there should be mentioned the considerable space and labor savings that can be effected. Owing to the reactor and controls requiring such a small floor area, it is usually possible to set the continuous hypochlorite system at an operating point, where manpower already assigned to other duties, can easily assume the minor observing and operating requirements of this system. Thus, all the bleach labor and nearly all the floor space

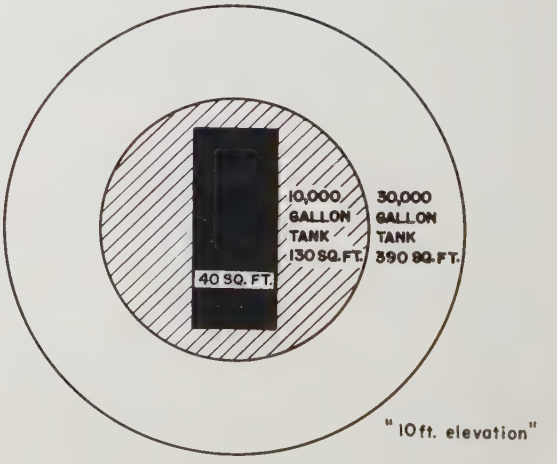

Fig. 7. Schematic comparison of floor area required

Table I. Cost Estimate

50,000-Gallon unit, 50 g.p.l. soda, bleach, single pass

Equipment		
Reactor	$ 200	
Piping and pumps	1595	
Tank, 2000-gal	1000	
		$2795
Instrumentation		3510
Control valves		
Chlorine, water, caustic		550
Total		$6855

presently occupied by a batch hypochlorite process, except one surge or storage tank, can be released for other uses. For those mills in need of additional space for proposed modifications or expansions of other plant processes, this savings in building space can represent considerable savings in outlay for construction capital. In addition, it is estimated that the labor savings effected by the use of a continuous system will pay for the equipment investment needed in about two years.

Figure 7 depicts schematically the relative floor areas required for a batch process versus that required for a continuous process. The floor space saved can range as high as 90%, depending on the rate of production and the amount of storage allotted at present to a batch system. The actual savings in bleach storage capacity will be determined by the minimum storage capacity judged adequately for maintaining pulp bleaching during routine and emergency shutdowns of the continuous bleach preparation system.

Construction materials for a continuous process are relatively simple. All piping can be of Uscolite. The caustic handling and dilution system may be of all-iron construction. The reactor column may be of glass or Uscolite construction. Pumps handling the bleach liquor should be Duriron. Bleach liquor storage tanks should be of neoprene-lined steel.

Table I gives a representative example of the material costs involved in the installation of a 50,000 gal. per day, continuous sodium hypochlorite manufacturing unit.

In summation, it may be stated that a continuous hypochlorite bleach liquor manufacturing system offers a pulp bleacher means whereby a considerable savings can be effected in space, labor costs, and chemical costs and by which a more uniform and constant bleach solution can be obtained. Many pulp mills throughout the country are currently using such systems in their bleaching operation with considerable success.

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A New Method of Finishing Coated Paper

FREDERICK H. FROST

A process is described in which typical, mineral coated surfaces, suitable for printing purposes, are raised to high finish levels without the brutal effect of calendering. The uncalendered coated surface is finished by passing it through a low-pressure nip under particular conditions of temperature, pressure, and moisture. The method is designed to maintain bulk, opacity, brightness, and resiliency. The process also offers an opportunity to diminish the waste and defects which are normally associated with calendering.

For many years the coated paper industry has, with great care and skill, evenly spread a mineral coating on a base paper made to exacting specifications. When you consider the extreme thinness of the coating applied and the uniformity of application that is attained, we have long believed that this is an acheivement of considerable magnitude.

Frederick H. Frost, Vice-President—Research, S. D. Warren Co., Cumberland Mills, Me.

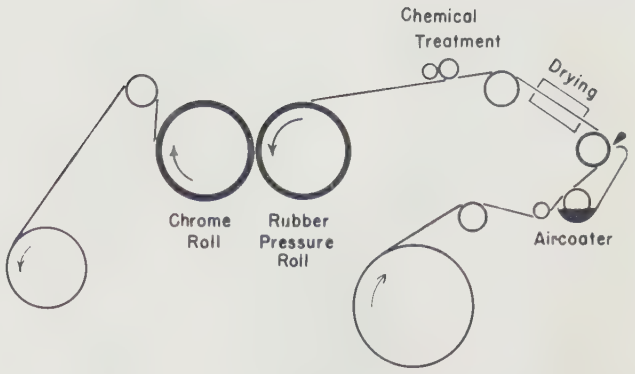

Fig. 1

This has been accomplished by a variety of intriguing and ingenious methods which are familiar to most of us. After coating, almost invariably, we then promptly pass the coated web through the heavy destructive pressures of calendering. This reduces bulk, brightness, opacity, and resiliency. Calendering is one of the principal causes of waste and it contributes a host of defects which plague our customers or swell our production of seconds.

All of us have dreamed of the day when a low cost, gentle, finishing method might be developed which would supersede calendering. Cast coating accomplishes this but, comparatively speaking, this is an expensive procedure. We present, today, a new approach to this problem of imparting a high finish to coated paper; this is a procedure we hope may at least reduce, if not eliminate, the dependence upon high-pressure calendering.

The concept is simple—as all good ideas should be. In this new process coated paper is pressed, with low pressure, against a hot, highly polished surface. Finish, we believe, is obtained by heat and pressure flowing a coating, high in mineral content, against a hot polished roll.

Figure 1 shows the design of an apparatus which will perform this function. The chromium-plated roll is, say, 48 in. in diameter and internally heated, the backing or pressure roll or rolls are rubber covered and form a nip, with the metal roll, of appreciable width.

Pressures per square inch are low and they may be as low as one-fiftieth that of normal calendering pressures. The polished roll is hot, often above the boiling point of water. Such temperatures are above normal calendering temperatures. We have added a coater, drying, and a chemical treating roll to the apparatus, as you will observe. We will consider these later.

Figures 2 through 6 show our concept of what happens when a coated sheet passes through this low pressure but hot nip. The first significant act occurs when the coating first touches the hot, polished surface at the point indicated by the arrow on Fig. 2A. Figure 2B shows that the coating may explode

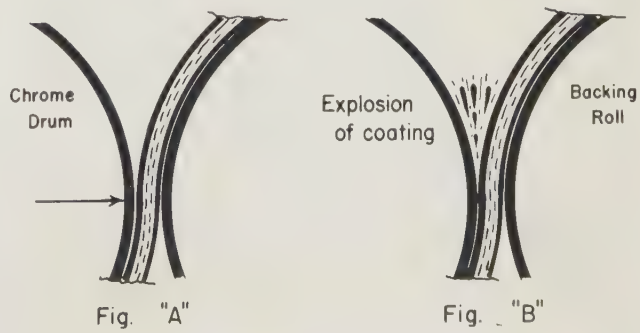

Fig. 2

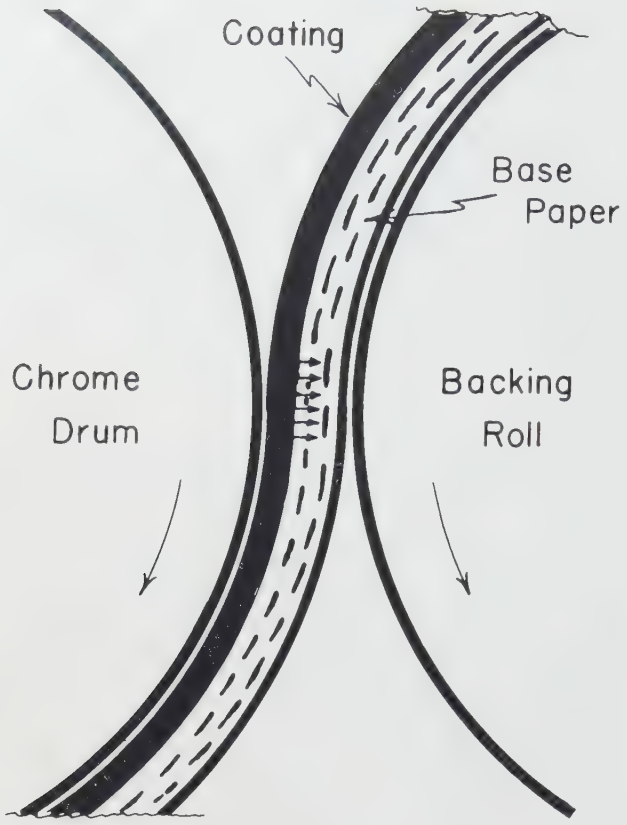

Fig. 3

at this point. To overcome this we must employ a coating which, through partial drying or through chemical means, will form a gel structure sufficiently strong to resist this shattering effect on contact with the hot roll.

Figure 3 shows the coated sheet in the nip. We visualize that the water in the coating becomes superheated and is driven into the body stock (as indicated by the arrows) which, as you will remember, may be half voids. The pressure per square inch of the backing roll against the chrome roll should be maintained at a higher pressure than the steam pressure corresponding to the roll temperature.

Figure 4 shows the coated sheet emerging from the nip. At this stage the superheated water turns into steam and this steam "explodes" or "flashes" out the back side, as indicated. That, in general, is the process.

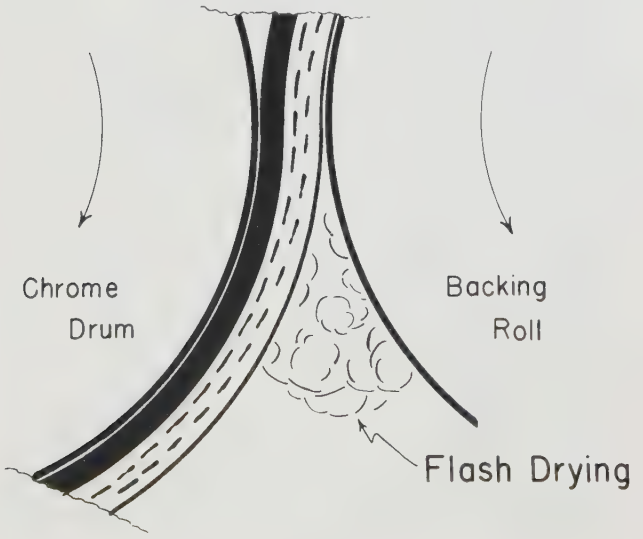

Fig. 4

We tend to be somewhat careless in our thinking in regard to moisture content. Normally we call paper "dry" when it contains 5% moisture, which after all is 100 lb. of water per ton of paper. At 5% moisture this process will work whereas at 1% moisture content we have had no success in obtaining a satisfactory, let alone an outstanding, finish and surface. We believe that moisture acts as a plasticizer, and the sudden increase in temperature provides a momentary mobility to the coating which allows it to conform, but not adhere, to the polished roll surface. You are all familiar with the very marked effect of increasing temperature on the viscosity of the coatings we employ. It is reasonable to assume that a coating even at very high solids will become mobile if the temperature is suddenly raised.

The process can also operate in the presence of high moisture content—say 10 to 15%; if the coating has been rendered less mobile by, for example, the hardening action produced by the sudden release of aluminum ions in the coating, such higher moisture levels may be required to give the desired finish and gloss.

Coagulants can be held in the coating in chelated complexes and later can be released by running the coating against a roll covered, for example, with a thin film of acid. This can give virtually an instantaneous change from a liquid coating to a solid coating. We think of this as chemical freezing. This procedure is one method of rendering a coating non-explodable as it enters the hot nip.

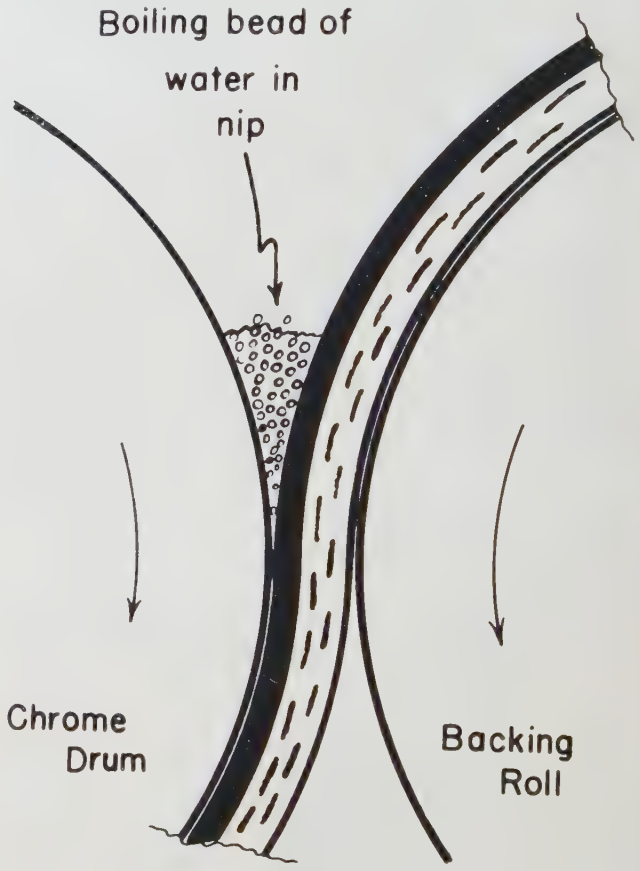

Fig. 5

Likewise the surface of the coated side which is to be pressed against the polished roll may be moistened prior to entering the nip. Figure 5 shows this type of operation and in this particular case we have the unusual situation in which water is actually boiling on the coated surface at the point indicated by the arrow. This can occur on coatings which contain either very small or excessive amounts of water if they have been sufficiently jelled to withstand such action. If you

will consider that we are not discussing a static process, but one in which the paper is running continuously and fast and that the coating is subjected to this boiling action for only a small fraction of a second, you will appreciate that this is practical.

As in all new procedures problems arise. It is possible, for example, with an overall moisture content of 5% to generate enough steam on emergence from the nip to thoroughly shatter the base paper—especially if it is light in weight. Care must be exercised to maintain proper fiber-bond and body-stock density or you will end up with two sheets of paper leaving the nip with only a single sheet entering the nip, as depicted in Fig. 6.

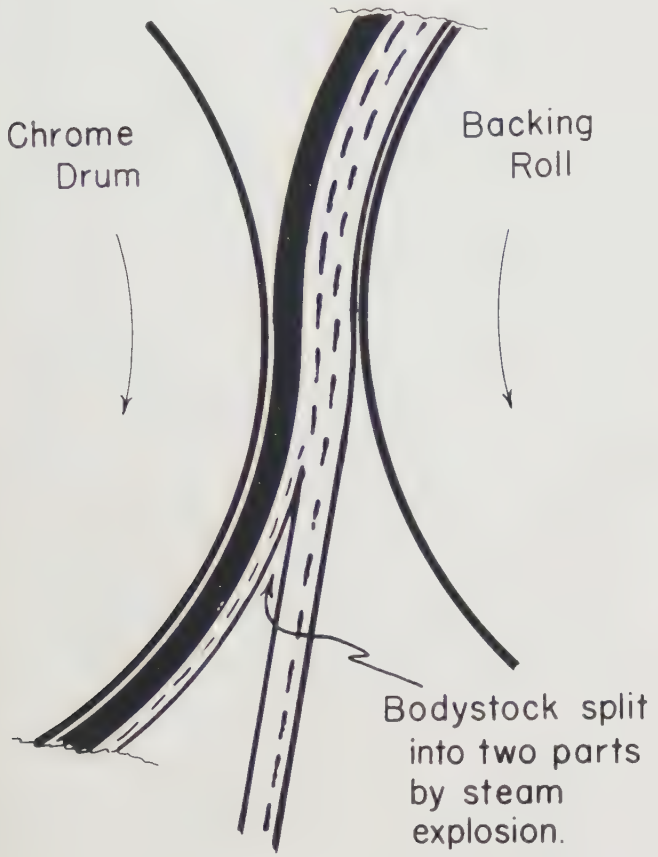

Fig. 6

There are important variables in the nature and in the type of adhesives and the minerals which may be used. It should be pointed out, however, that we are dealing with coatings—high in mineral content and low in adhesive percentage and not with clear, heat flowable, thermoplastic film-forming resins, which present quite a different problem and produce a different product.

Speed, roll pressure, nip width, roll composition, roll hardness, temperature, the smoothness of the polished roll, etc., may all be variables. Properly balanced, speeds in excess of 600 f.p.m. are attainable. It will be evident to you that this process has the potential of being incorporated as a part of other paper making procedures, as for example, putting such a unit on the end of a paper machine or coater.

This new process is described and covered by the claims of U. S. patent 2,919,205. There are other applications pending. We are hopeful that as this development progresses it may prove to be at least a forward step in escaping from the destructive influence of calendering on coated paper.

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Deinking—Present and Future

A. J. FELTON

This study collects and puts into perspective, technical, and economic data concerning recognized types of deinking systems. Flow diagrams and descriptions of some systems are made public here for the first time. The history of deinking development is reviewed from 1695 to 1960. Descriptions of 10 systems in current use are based on a recent survey of the industry. Stress is placed on the choice of equipment, chemical consumption, bleachability, fiber yield, and water consumption of each. The economic importance of deinked fiber is analyzed statistically, and its role in conserving primary fiber sources is noted. Future development of more effective deinking systems is treated in a discussion that embodies the opinions of at least 10 experts in the field.

We are met on the threshold of the golden 60's, with a forecast for the paper industry of continued expansion and prosperity. In all fields of papermaking we hear of noteworthy events. For instance, a southern machine makes over 1050 tons of kraft linerboard in one day, another machine introduces revolutionary two-way stretch paper, machine speeds reach 3000 f.p.m., and super news machines are built 350-in. wide.

But in deinking, not much of anything appears that is truly praiseworthy, so, we must look to the future for something outstanding—some method that will measure up to our standards of note.

Deinking, if we are to believe published statistics, is a section of our paper industry that is not expanding at a rate consistent with the balance of it. Frankly, it appears to be losing ground on the basis of these statistics.

We all know we lack adequate raw materials to keep on building new mills indefinitely. Moreover, with rising costs and possible foreign competition from the "common market" and the "outer seven" as well as iron curtain countries, we must re-use our "scrap" to maintain a competitive position. Modern, efficient deinking systems with continuous, straight through defibering and cooking and with present continuous cleaning and washing would go a long way to protect our economic position.

In order to design the deinking mill of the future we must scrutinize its requirements. The system should be designed like any other pulp producing unit to treat specific types of material, in this case, a type or types of wastepaper and to process them to produce pulps for definite end uses. If a mill desires to use high quality, white papers, the deinking plant will need equipment to produce high brightness, uniformly clean stock, free of groundwood and with acceptable strength properties. If the interest is in high yields, low to medium brightness with no restrictions in groundwood content, a specific type and arrangement should be designed for this purpose.

Since mechanical action, temperature, chemical concentration and time are interchangeable, changes in equipment, efficiency and temperature should reduce equipment size. By heat and chemical recovery, it should be possible to prevent excessive chemical usage.

The deinking mill of the future will be a carefully engineered plant, specifically designed for deinking, unlike most present systems which were put together with whatever equipment was readily available. In many cases this was accomplished with obsolete equipment and inadequate space.

It will be fully automated and will eliminate hand sorting by progressive and continuous rejection of nonfibrous materials while progressively and continuously heating, defibering, and adding chemicals. The rejects will be coarse at first

A. J. Felton, Executive Sales Engineer, The Black-Clawson Co., Shartle Division, Middletown, Ohio.

ejecting and will be separately reworked for possible reclamation of suitable fibers. The balance of rejects will be discarded. The reject system may be constructed like a cycling tower or rotary lime kiln with special purpose devices spaced progressively up the cylinder.

The decreasing yields due to higher groundwood content and ever increasing amounts of clays and fillers will require the system to handle larger tonnages than at present in order that the same tonnage of secondary fiber may be recovered.

Most cleaning systems today take care of the normal amount of foreign materials but are totally inadequate for the "slugs" of excessive dirt, tacky materials, and other objectional plastic or latex binderage. This material is difficult to detect in the bales as received from the waste dealer and, once in the process, renders the entire batch unsuitable for paper making. As little as one pound of this material in a 5000-lb. batch renders the entire batch unfit for papermaking.

There is a slight possibility that fractional separation of dirt, tacky material and other matter by means of specific gravity could overcome this problem. Centrifugal separators as we know them today are not completely adequate. Even with expensive pumps, piping, close supervision and maintenance, tacky material having specific gravities different than that of the fiber itself tend to remain with the fibers. Clay and other fillers having specific gravities different than carbon black can be partially removed but as yet the centrifugal separation principle cannot do the entire job. In order to obtain the desired separation it will be necessary to develop equipment as yet unthought of, perhaps ultrasonic. Improved washers and thickeners will help in reduced initial equipment investment. Separation of undesirable materials at high consistencies would make substantial reduction in costs through the use of smaller washers, pumps, and storage facilities.

The problem of tacky material reducing the quality of deinked pulp has long been recognized by the deinking industry. Efforts on the part of the Deinking Committee of TAPPI to encourage and finance a research project to obtain information concerning all types of rubber adhesives and other plastic materials are continuing.

In 1947 the dollar value of papermaking raw material consumption in the United States exceeded the dollar value of raw material production. Since that time the trend is toward a greater discrepancy and the history of nations show that this position is irreversible. This makes us dependent upon other nations for substantial amounts of raw materials. One method to alleviate this dependency is to give materials two or more lives by better "scrap" utilization.

"Scrap" utilization presupposes that the scrap in itself is usable and/or that there are methods for reclaiming it. The formation of the Waste Paper Utilization Council was a step toward realization of this useability goal. This Council was formed to advise the waste dealers of the papermakers

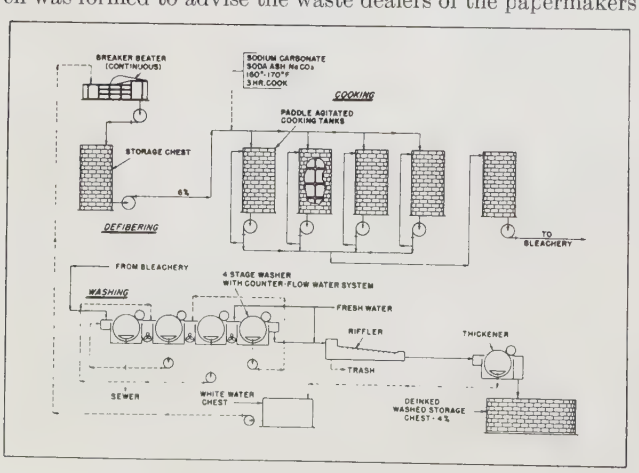


Fig. 1

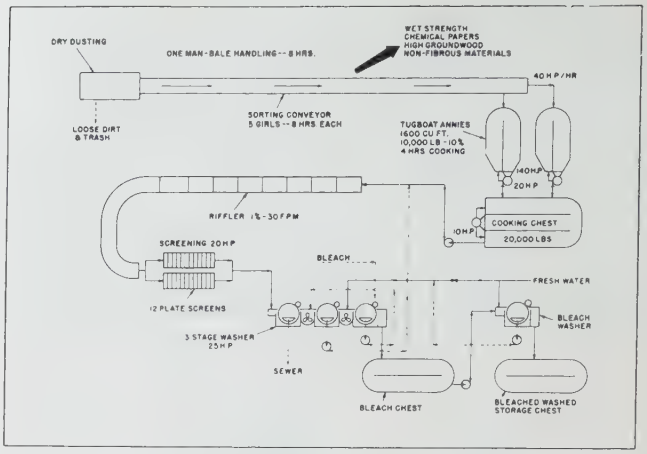


Fig. 2

problems and how they contribute to them by including nonfibrous material in their wastepaper bales. In addition, the Council works with converters and printers to anticipate troublesome procedures before they reach any magnitude. On encountering objectionable foreign materials, the Council will often recommend suitable substitutes that will not render a paper product unfit for reclamation.

Even with this precaution, large amounts of wastepapers remain unusable because they contain plastic and latex binderage which produce sticky spots. It is difficult to estimate the amount of material rendered practically useless by this material but conservative estimates by paper journals are upwards of two million dollars annually. The loss in direct deinking operations is generally agreed to represent 5% of current production.

BLEACHING

Since users of magazine and book papers will be faced with higher percentages of groundwood in the wastepaper of the future, it will be necessary to go to multistage bleaching and, in particular, to one or more stages not common at present,

COST PER TON FOR DEINKING—1935

LABOR:		
Sorting-Man hours	8	1 Man 8 Hrs.
Girl hours	40	5 Girls 8 Hrs.
Pulping & Cooking	24	
Washing	24	
	56	Man hours = 2.33 Hrs./Ton
(24 ton)		40 Girl hours = 1.66 Hrs./Ton

LABOR:	
Man hours 2.33 at .60	1.50
Girl hours 1.66 at .40	.67
POWER:	
331 H. P. hours (24 × 300 days)	2.32
HEAT:	
291 lb. (12,000 B.T.U. coal) at 3.50 T.	.50
SODA ASH:	
60 lb. at 1.05 CWT	.64
CAUSTIC SODA	
60 lb. at 2.50 CWT	1.50
BLEACH:	
36 lb. at 2.00 CWT	.72
WATER:	
42,500 gal. at .005	2.12
RAW MATERIAL DELIVERED	25.00
Shrinkage 18%	4.50
AMORTIZATION OF INSTALLATION	
(20 yr. life (112,000 + 110,000))	2.00
	$41.48
COST OF VIRGIN PULP	$52.00
NET SAVINGS PER TON	$10.52

Fig. 3

that is, chlorination, caustic extraction, peroxide, last stage, etc. It is quite conceivable that 80 to 85% of groundwood would be reclaimed for fine paper use if chemical costs and low yields did not make it uneconomical.

Studies are being made of two- or three-stage bleaching with 35 to 40% groundwood in order that higher groundwood content papers in the publication field might be reclaimed. Groundwood in these fine papers will give greater opacity and improve printability to the finished sheet and will permit production of lighter weight papers requiring lower postal charges.

Papers using some percentage of secondary deinked stock are advantageous in offset reproduction, which is dependent upon the balance of ink and water. Primary fibers seem to have a greater affinity for moisture, especially those manufactured by the sulfate process. When wet these fibers change their dimensions, resulting in misregister of multicolored forms. Higher percentages of secondary fiber give greater dimensional stability to the sheet so that misregister problems are not encountered when the moisture content changes from one ink color to another.

Also, it appears that, in addition to improved opacity we get better density and therefore a smoother surface either for coating or for the actual printing if it is book stock. With these two characteristics you can normally expect a truer reproduction from halftone and multicolor work because they give greater degree of uniform ink receptivity.

The future of deinking is a bright one. If we can eliminate some of the troublesome elements of book making and improve our equipment for a nonfibrous trash removal, we would be in a position to take a long step toward balancing our raw material production and consumption. The profit margin between paper production and production costs would also be increased.

PRESENT PRACTICES

To appreciate the development of the deinking system, we would like to present a pictorial evolution of the deinked system and some production costs records. This historical record begins with the initial deinking conception.

The re-use of printed papers through deinking was first accomplished in the Danish mill of George Illy in 1695 (250 years ago). Also 100 years later the first patent on deinking was granted to England to Matthias Koops.

The rapid expansion of the papermaking industry in the early 1800's produced a large quantity of wastepaper that had to be re-used or destroyed. Some easy re-use outlet had to be found at a cost favorable to the price of virgin pulp. The use of wastepaper for building material, board, and deinking seemed to fill the economic need.

At first only rag and chemical wood pulps were deinked. Groundwood was not present in printing papers. As more grinding apparatus was installed it soon became necessary to sort the papers for deinking to avoid the presence of more than 5 to 10% of mechanical pulp in the deink batch.

The use of sodium hydroxide (caustic soda) was common in deinking plants because it saponified the resinous base of the inks and retarded the redisposition of the carbon black onto the fibers. Clay fillers used in the papers attracted the loosened ink particles and carried them off in the washing process.

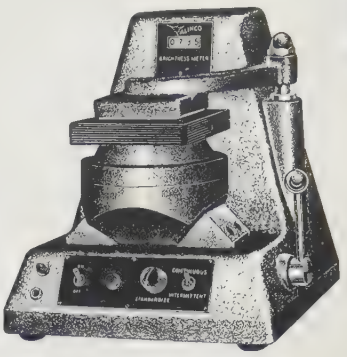
In the 1920–30's large quantities of mechanical pulp papers in the form of telephone directories and books were recovered by one large mill in sizable quantities by controlling the ink making method. (They even went so far as to manufacture and supply the ink free of charge.) Sulfur dioxide dissolved in water was used as the dispersing agent and the pulp was washed free of inks by conventional washing methods. This process also increased the brightness of the pulp. Increases in labor and materials as well as faster ink drying requirements forced discontinuation of this process in favor of the sodium peroxide–sodium silicate process we are now familiar with. The ink preparation was also changed to permit higher press speeds and almost instantaneous ink drying.

In order to cope with the increased demand of the deinking system to handle all sorts of trash and nonfibrous material, changes in equipment, process, and chemicals started a gradual evolution.

Figure 1, for instance, shows a typical deinking system for 1932. The continuous breaker beater broke up the furnish sufficiently to be pumped to the cooking tank where soda ash could be added and the batch held at elevated temperatures for three hours before bleaching. Note that the bleaching was attempted with the ink still present, and conventional washing and settling troughs removed what impurities they were capable of.

By 1935 one mill had progressed to a point that they considered it necessary to remove by dry dusting and manual sorting such impurities that could be visually recognized, as well as groundwood content papers (Fig. 2). After batch pulping in Tugboat Annies and a retention cooking chest, the stock proceeds to continuous settling, screening, multistage washing, bleaching, and bleach washing.

Another of a series of files of precision products by ALINCO



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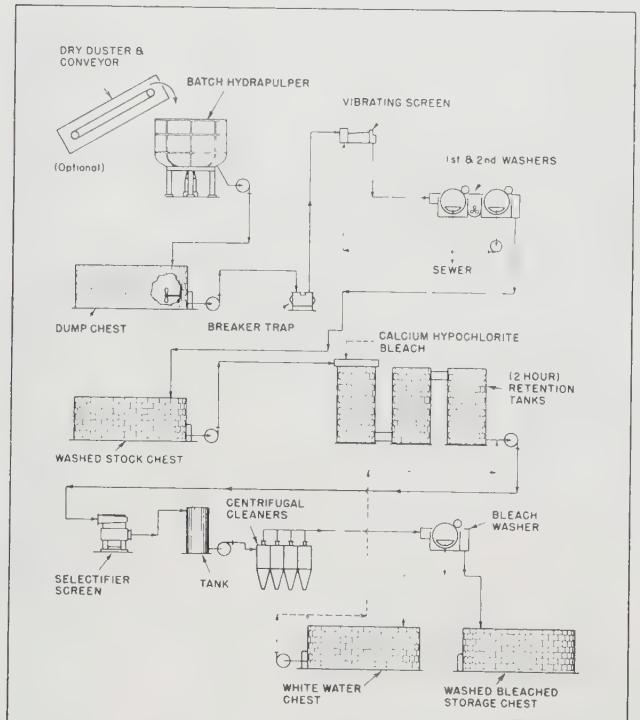
COMPARISON OF COSTS FOR DEINKING

	1935		1960
LABOR:			
Man hours 2.33 at .60	1.50	at 2.60	6.050
Girl hours 1.66 at .40	.67	at 1.65	1.755
POWER:			
331 H.P. at .007 H.P. Hr.	2.32	at .0153	5.064
HEAT:			
291 lb. Coal at 3.50	.50	at 7.00	1.000
SODA ASH:			
60 lb. at 1.05 CWT	.64	at 1.85 CWT	1.120
SODIUM HYDROXIDE			
60 lb. at 2.50 CWT	1.50	at 4.30 CWT	2.580
BLEACH:			
36 lb. at 2.00 CWT	.72	at 3.95 CWT	1.425
WATER:			
42,500 gal. at .005 M	2.125	at .01 M	4.250
RAW MATERIAL:	25.00	at 39.00	39.000
Shrinkage 18%	4.50	45%	17.550
AMORTIZATION OF INSTALLATION (20 yr.) ($222,000.)	2.00	at 549,000	6.293
TOTAL	$41.48		$86.09
COST OF VIRGIN PULP	52.00		155.00
	−41.48		−86.09
NET SAVINGS PER TON	$10.52		$68.91

Fig. 4

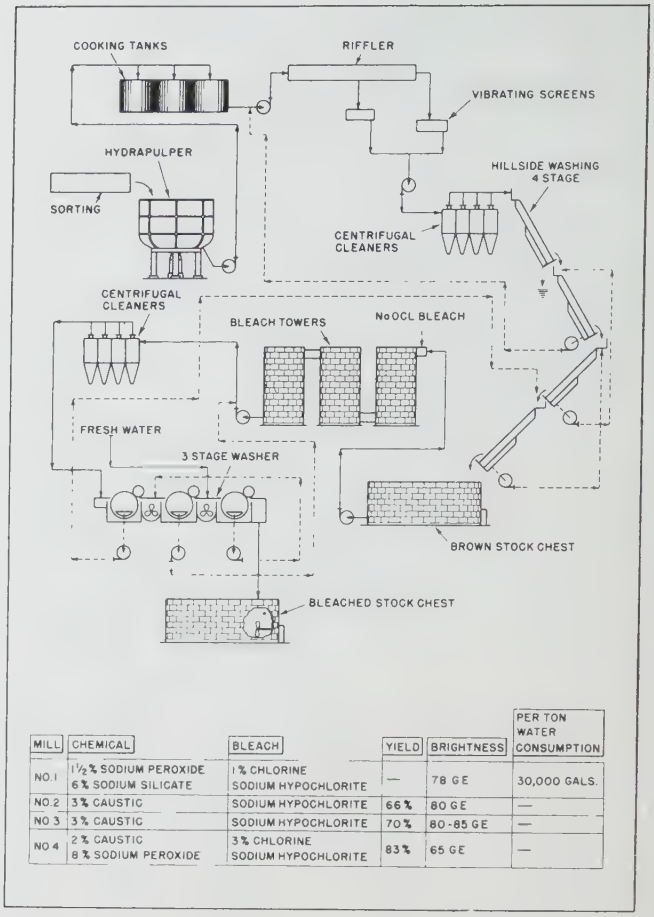
This system provided a favorable margin of 20% over virgin pulp costs after all costs had been accrued (Fig. 3).

I thought you might be interested in a direct comparison of 1935 costs to those of 1960 (Fig. 4). With the natural increases and inflation reflected in the cost structure there is still a very substantial margin of saving realized.



MILL	CHEMICALS	BLEACH	YIELD	BRIGHTNESS	PER TON WATER CONSUMPTION
NO 1	3% CAUSTIC 1½% SODIUM SILICATE	CALCIUM HYPOCHLORITE	76%	80 GE	25,000 GALS.
NO 2	4% CAUSTIC	SODIUM HYPOCHLORITE	75%	78-80 GE	—
NO 3	2½% CAUSTIC 2½% SODIUM SILICATE 3% SODIUM CARBONATE	SODIUM HYPOCHLORITE	80%	75-80 GE	30,000 GALS.

Fig. 5. Ledger deinking



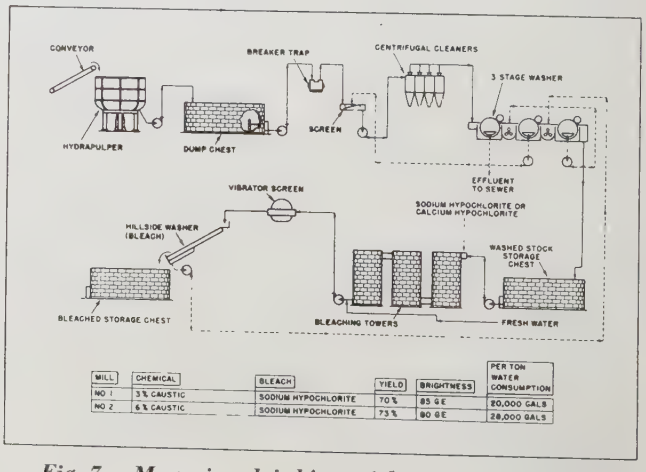
MILL	CHEMICAL	BLEACH	YIELD	BRIGHTNESS	PER TON WATER CONSUMPTION
NO.1	1½% SODIUM PEROXIDE 6% SODIUM SILICATE	1% CHLORINE SODIUM HYPOCHLORITE	—	78 GE	30,000 GALS.
NO.2	3% CAUSTIC	SODIUM HYPOCHLORITE	66%	80 GE	—
NO 3	3% CAUSTIC	SODIUM HYPOCHLORITE	70%	80-85 GE	—
NO 4	2% CAUSTIC 8% SODIUM PEROXIDE	3% CHLORINE SODIUM HYPOCHLORITE	83%	65 GE	—

Fig. 6. Magazine deinking with cooking tanks

Let me caution you—don't leave this meeting and search for a spot for a similar system in your mill because of the 44½% margin shown. The quality of pulp to be realized from this system will be considerably below that required for the present day production. In addition, the raw materials will contain material and nonfibrous matter that this system could not cope with.

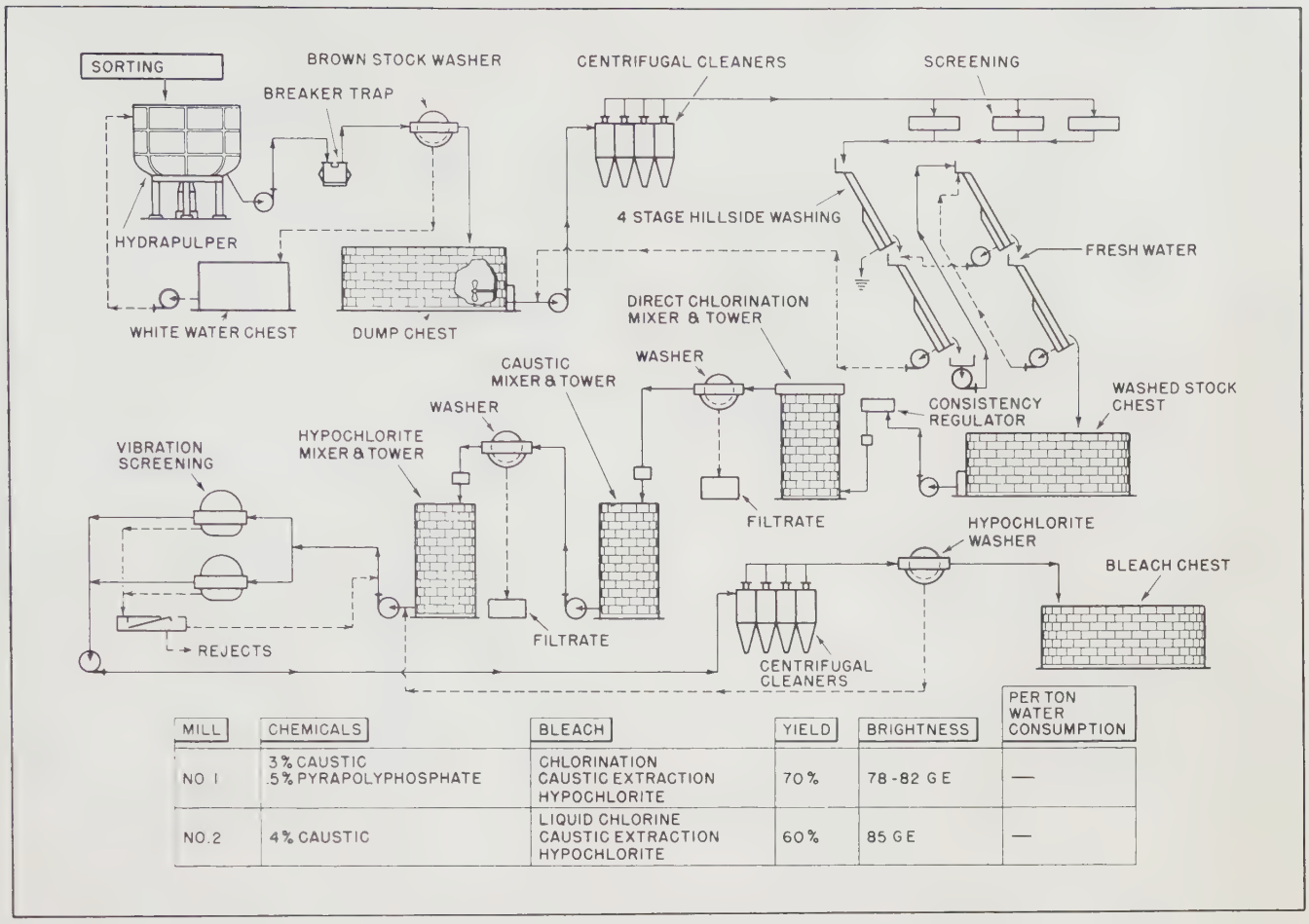
Since 1935, deinking processes have been specifically developed for the type of wastepaper to be furnished. At the present time systems for three major grades are used; (1) ledger—kraft and sulfite, (2) magazine—coated and filled, and (3) high groundwood content—news and telephone directory.

To determine the facts of life of our deinking industry we examined data of many deinking systems from which a composite picture might be drawn and be representative of equipment and order of continuity for each of the aforementioned major categories.



MILL	CHEMICAL	BLEACH	YIELD	BRIGHTNESS	PER TON WATER CONSUMPTION
NO 1	3% CAUSTIC	SODIUM HYPOCHLORITE	70%	85 GE	20,000 GALS
NO 2	6% CAUSTIC	SODIUM HYPOCHLORITE	73%	80 GE	28,000 GALS

Fig. 7. Magazine deinking without cooking tanks



MILL	CHEMICALS	BLEACH	YIELD	BRIGHTNESS	PER TON WATER CONSUMPTION
NO 1	3% CAUSTIC .5% PYRAPOLYPHOSPHATE	CHLORINATION CAUSTIC EXTRACTION HYPOCHLORITE	70%	78-82 G E	—
NO.2	4% CAUSTIC	LIQUID CHLORINE CAUSTIC EXTRACTION HYPOCHLORITE	60%	85 G E	—

Fig. 8. Continuous deinking—magazine

Ledger

Reclamation of high-strength fibers from ledger, IBM card, and sulfite papers was accomplished with a good measure of success with the system shown (Fig. 5). It consisted of batch hydrapulper for defibering followed by continuous system of secondary defibering, washing, single-stage bleaching followed by screening, centrifugal cleaning, and bleach washing. The yield was in the order of 75% of furnished weight. The product made with this stock contained as much as 70% deinked fiber.

Magazine

Publication and coated papers are reclaimed through somewhat similar systems. In the first (Fig. 6) the system consists of a batch hydrapulper followed by cooking tanks, settling trough, screening, centrifugal cleaning, and washing. Following this is a single-stage bleaching operation, second-stage centrifugal cleaning and bleach washing. This system gave pulp with good brightness and yield. Counterflow water system held water consumption to 30,000 gallons per ton.

The second method for magazine stock (Fig. 7) differs only in elimination of the cooking tanks. Approximately the same quality and yield is realized.

The third method is a radical departure from the first and second (Fig. 8). In this system the deinking operation is on a continuous basis. Furnish, water, and chemicals are fed into the hydrapulper continuously while the defibered stock is removed continuously. A secondary defibering stage is provided and a brown stock pressure washer to recover as much heat and chemical from the stock as possible. This recovered effluent is returned to the hydrapulper without

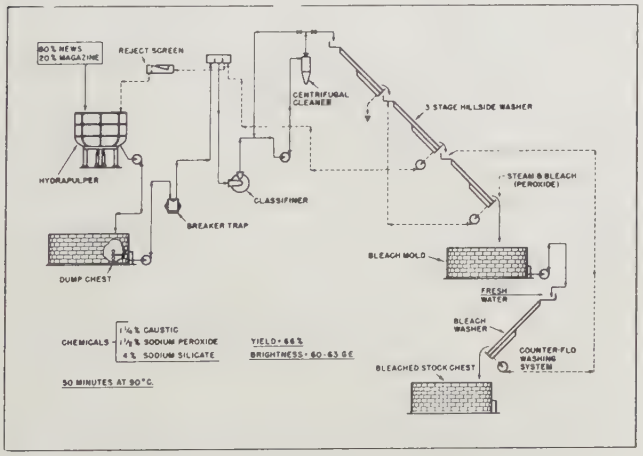
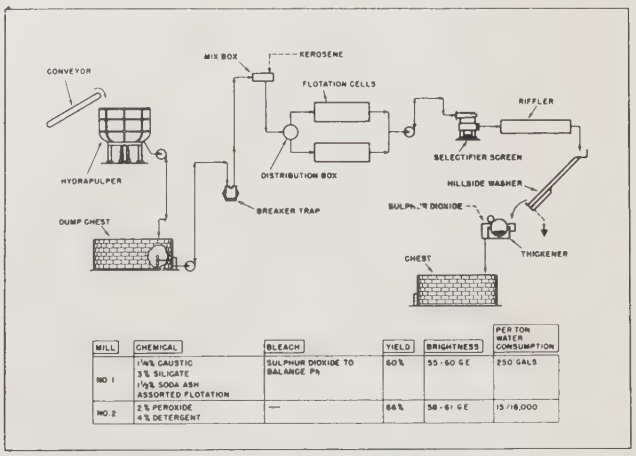


Fig. 9. Newsprint deinking—European mill



MILL	CHEMICAL	BLEACH	YIELD	BRIGHTNESS	PER TON WATER CONSUMPTION
NO 1	1½% CAUSTIC 3% SILICATE 1½% SODA ASH ASSORTED FLOTATION	SULPHUR DIOXIDE TO BALANCE PH	60%	55-60 GE	250 GALS
NO.2	2% PEROXIDE 4% DETERGENT	—	66%	58-61 GE	15/18,000

Fig. 10. Newsprint deinking

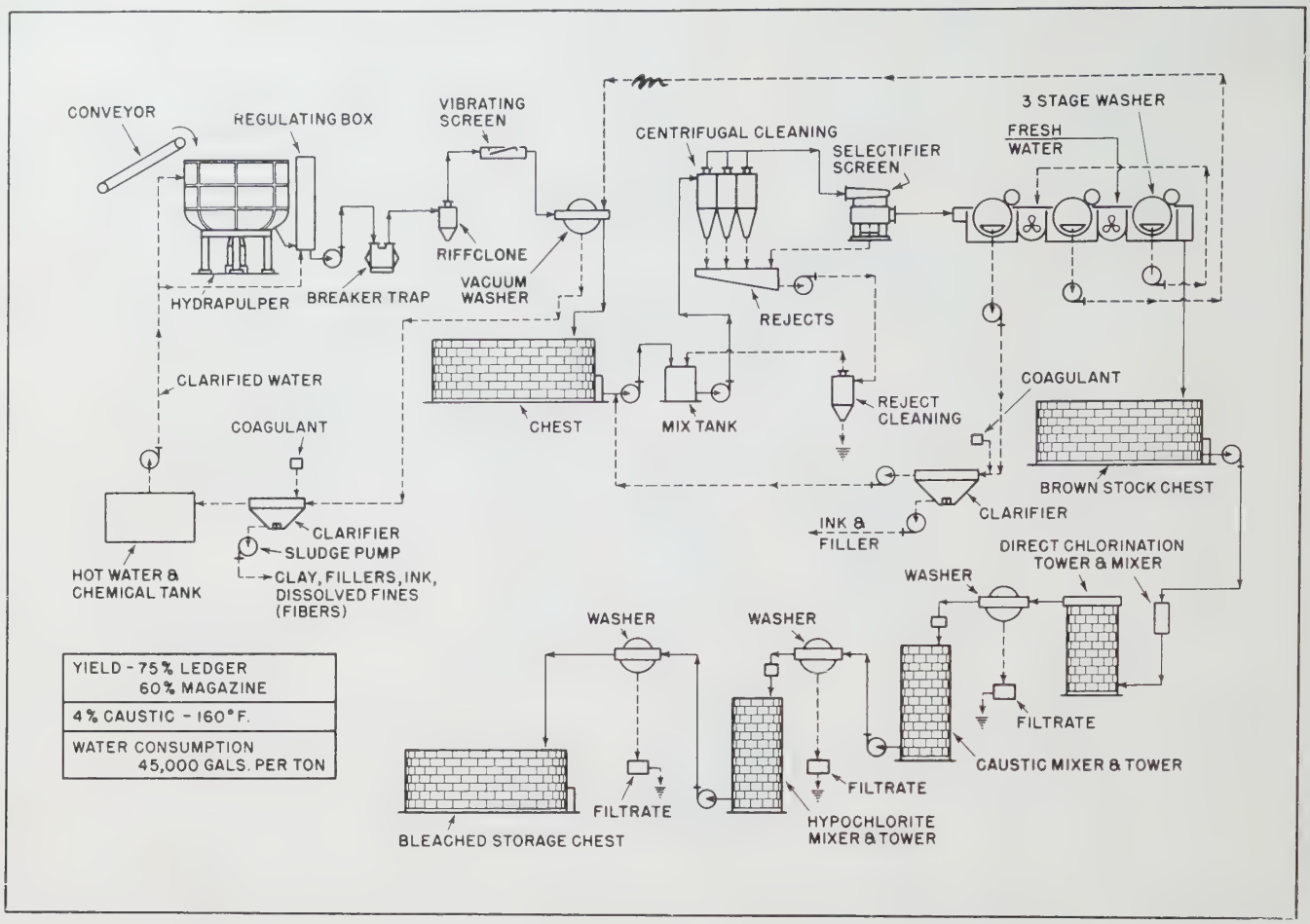


Fig. 11. Deinking modern ledger—kraft and sulfites—magazine-coated paper

further treatment. The balance of the system comprises centrifugal cleaning, screening, and washing. A three-stage bleach system is provided consisting of chlorination, caustic extraction, and sodium hypochlorite. Bleach washers vacuum type are provided between chlorine and caustic and hypo stages. From the hypo tower the stock is screened through fine machine screens and machine centrifugal cleaners before final hypo washer.

The yield is somewhat lower than that of systems 1 and 2 but the stock is much cleaner and brighter.

Important savings from these systems have been reported at:

45% reduction of caustic
50% soda ash
35% reduction in shrinkage
40% reduction in water
40% reduction in steam

We have not verified these statements. You will note that a substantially larger initial investment is required for this system as compared to systems 1 and 2.

Newsprint

There is little deinking of news in the United States. Generally, the cost of mechanical fiber produced in large quantities and delivered to eastern markets does not provide a favorable margin to deink. However, recent work with detergents has rejuvenated this process.

We were fortunate in obtaining data from one European mill (Fig. 9). This system consisted of a batch hydrapulper followed by a continuous defibering, coarse screening, centrifugal cleaning, and washing. A single-bleach stage was provided with bleach washer. The yield was good and brightness suitable for re-use.

The few domestic news deinking operation are similar except that flotation washing is used. The flotation cells greatly reduce the water consumption for washing.

This system was also used for magazine furnish and the following costs were reported:

Soda ash, silicate, tripolyphosphate fatty acid soap, pine oil, and kerosene	$ 1.10
Labor	4.26
Steam	2.28
Power	4.35
Water	0.38
	$13.47

The yield was from 65 to 82% since there was no loss from conventional washing.

FUTURE

Drawing on the technical knowledge gained in the past and bearing in mind the limitations of equipment available, it is our opinion that the optimum system for the deinking of ledger and magazine furnish would be as shown (Fig. 11). This proposed system recovers unexhausted chemical and heat immediately after pulping. By use of continuous clarifier and coagulant, the fillers, clays, and ink would be removed as sludge before this effluent is re-used. This arrangement not only provides for maximum economics in heating and chemicals but removes the clays and fillers early in the system so that bleaching can be more complete and more easily accomplished. This particular arrangement takes advantage of the knowledge we have gained in bleaching operations which indicates that deinked stock containing clays and fillers with ink and caustic is more difficult to bleach the longer it is retained without washing.

Adequate screening and centrifugal cleaning removes the nonfibrous materials before brown stock washing. The brown stock washers are arranged with countercurrent water

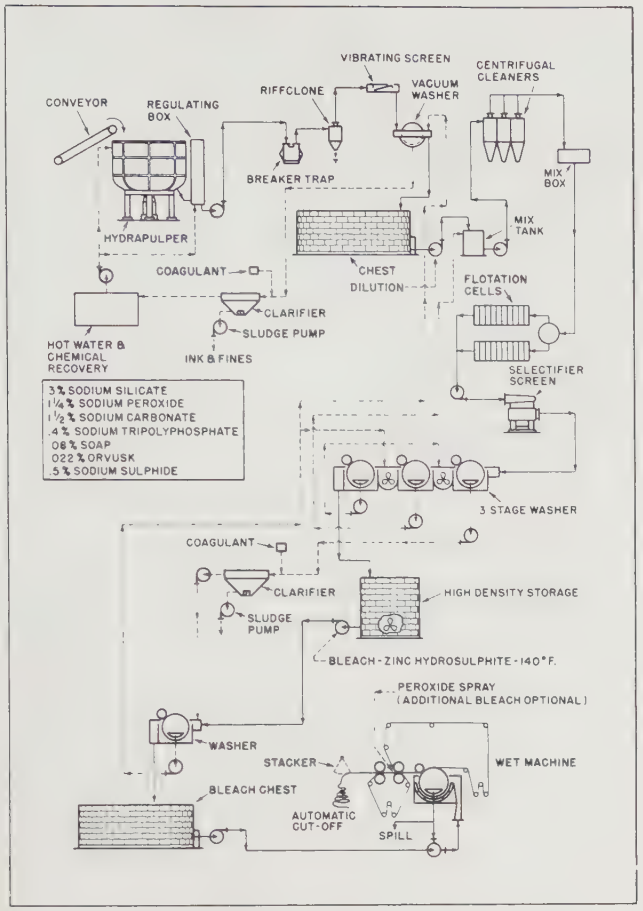


Fig. 12. Modern newsprint deinking

flow system to reduce water consumption. The first-stage effluent is clarified in a continuous water and solids coagulating tank, and the clarified water is re-used in the system.

This system should give well cleaned, high brightness pulp at reasonable chemical and operating costs. The yield should be in the order of 75% for ledger with good strength qualities. Magazine yield should be in the order of 60%.

Water consumption will be high due to three-stage bleaching and all effluent being sent to the sewer.

The newsprint deinking system of the immediate future would be as shown (Fig. 12). It has similar features for heat on (Fig. 11). Some of the chemicals are provided for use in the flotation washing system. This is accomplished by virtue of the mix box where these compounds are added to the diluted stock just before flowing into the flotation cells. The ink is removed as froth which floats to the surface and is scraped off by cleaning mechanism. Clays, fillers, and coating settle to the bottom of the cells and are removed as sludge. The washed or cleaned stock flows through the cells and into the centrifugal cleaners and screens that follow.

From the screens the stock is thickened and bleach is added. A suitable size bleach mold is provided as well as a bleach washer.

Zinc hydrosulfite has been used to good advantage in some systems. Its instantaneous bleaching action in air-free atmosphere permits it to be added to flash-steam-heated stock at the discharge of the storage chest and immediately washed on the bleach washer.

If additional bleaching is desired, a wet lap machine can be utilized and sodium peroxide sprayed on the sheet as it is lapped. This will permit bleach exhaustion while the laps are in storage.

The effluent from the washing stages can be clarified and re-used as shown. We would expect this operation to have a water consumption rate of 250 gal. per ton as compared to 20,000 gal. per ton conventional. The yield is 66% at a brightness of 72 G.E.

The cost of deinking high groundwood content papers should be $55 to $60 per ton allowing $20 for raw material. This compares very favorably to purchased groundwood at $90 per ton. Reports from large grinding mills indicate that the size of their operations reduce this margin to a point where it is not economical to recover fiber except for natural resources conservation.

CLOSING

We are a long way from our goal—the deinking of mixed wastepaper into clean, white, strong pulp—literally, the changing of a sow's ear into a silk purse.

To realize this dream, system designers, equipment manufacturers, and paper producers will have to pool their knowledge, allow the most fantastic ideas to be presented and tested. When the ideal system is created, I am sure most of us will hardly be able to recognize the equipment or the sequence of operation.

Let me paraphrase the remarks of one well-known deinker who said this in answer to my question "what do you want of your deinking system in 1970?"

1. Cleanliness—equal to market pulp.
2. Yield—70 lb. pulp for every 100 lb. furnished.
3. Brightness—controlled between 75 and 90 GE.
4. Chemical—water only.
5. Bleach—single-stage self-neutralizing.
6. Reversion—greatly reduced from present values.
7. Power—same as today.

In addition he believes the sequence of releasing bonds would have to be progressive and in this order:

1. Ink to pigment.
2. Ink to fiber.
3. Adhesive to fiber.
4. Adhesive to pigment.
5. Filler to fiber.
6. Fiber to fiber.

If his hopes are to be realized then we must develop new machines, new methods, and utilize principles of papermaking as yet untried.

The future will certainly bring more knowledge to all of us. Board mills, especially those of marginal size and production, can look to deinking as a source of good, low cost liner furnish that will strengthen their economic position.

Tomorrow's deinking system will furnish magazine, publication and high grade paper mills a low cost secondary fiber, well below market price of virgin pulp, that will reduce operating costs without loss of quality.

Thus, deinking can become an important factor in the conservation of our dwindling supply of natural wood fibers.

BIBLIOGRAPHY

1. TAPPI Monograph No. 16, pp. 1, 2, 11, 12.
2. James A. Lee, *Chemical Engineering*, January, 1948.
3. Sidney D. Wells—225-B American Colloid Co., Chicago, Ill.

APPENDIX

WASTEPAPER SUPPLY ANALYSIS

Few people realize the importance of the wastepaper portion of our industry. Over the years the supply of wastepaper for re-use has expanded until it has reached over 9,300,000 tons this past year. Calculated at a rate of 120 cu. ft. per ton, it equals to one billion, 116 million cu. ft. or one square mile 40 ft. deep. This material represents only one third of the actual amount produced since two thirds of the supply goes into permanent storage as file records, building materials, etc., or is destroyed. If this paper does not find re-use in our industry, the demand on our forests will increase 19%, and raw material production and consumption will soon force a standstill in new mill installations without older mills being shut down.

The wastepaper collection and handling problem is complicated by the fact that the supply of wastepaper is seasonal.

For instance, 15 to 20% increase in collection tonnages are recorded at spring cleaning time when papers stored through the winter are released to paper collection agencies. These fluctuations cause unbalance of labor, storage, and demand. It may be interesting to examine some recent production figures. In 1950 alone, 25,500,000 tons of paper was produced. Eighty per cent was reclaimable which amounts to 20,000,000 tons. Of this supply, 37% was reclaimed (7,500,000 tons). In addition, between 400 to 500 thousand people are gainfully employed by the wastepaper industry, which has an annual business volume of $500,000,000.

All this raw material is available 3 to 4 months from the time it is produced but only 15% is suitable for deinking and high grade paper production.

This amounts to approximately 500,000 tons with a yield of 330,000 tons after deinking.

Value (39 per ton)	$19,500,000.00
Chemicals used amount to (20 thousand tons)	1,380,000.00
Estimated horsepower (46 kw.-hr. 20 @ 1.23 tons)	615,000.00
Estimated steam-coal	5,825,000.00
Estimated water (10 thousand million @ $13)	1,300,000.00
	$28,620,000.00

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I would be remiss if I did not credit the many people without whose help this paper could not have been prepared and delivered: Al Alteri, Tileston & Hollingsworth Co.; Doyle Boggess, Beveridge Paper Co.; Jim Forsythe, International Paper Co.; Tom Meehan, Crown Zellerbach Corp.; Ward Harrison, Allied Paper Corp.; John Clouse, Oxford-Miami Paper Co.; John Brown, Pacific Press Co.; Merle Wilkins, Kalamazoo Paper Co.; Ralph Kumler, Waste Paper Utilization Council.

Low-Power Cold Soda Pulping

E. R. GREMLER and J. N. McGOVERN

A brief review of the history of cold soda pulping is given. Different cold soda pulping methods are discussed with special emphasis on continuous methods. Pulping data are given on different woods and evidence offered that short impregnation periods and low horsepower are favorable to obtain completely defibered pulp at high freeness. Power inputs of 9 to 13 hp. per day per ton are reported for the defibering operation when conducted with the Chemifiner—a newly developed, high density defibering machine. The principle of this machine and its contribution to the low horsepower consumption and improved quality of the cold soda pulp is explained. Brief mention is made of bleaching cold soda pulp. Some specific applications of cold soda pulp and the future potential of this pulp in the paper industry are discussed.

HISTORY AND DEVELOPMENT OF COLD SODA PULPING

The idea of treatment of wood chips at room conditions with caustic soda or other alkaline reagents with simultaneous or subsequent mechanical defibering was apparently first expressed in a patent about 40 years ago [Opfermans, E., German patent 349,880 (1919)]. Variations of this idea were later patented elsewhere [Tracquair, John, U. S. patent 1,936,697 (Nov. 28, 1932) and Woodhead, Robert, Australian patent 17342–34 (April 27, 1934)]. These patents, however, were restricted to the process and gave no indication of the applications of the process to specific fibrous raw materials or pulp and paper products.

It was not until about 10 years ago that the process now called "cold soda semichemical," or simply "cold soda," first received systematic investigation at the Forest Products Laboratory, Madison, Wis. This development was undertaken with the objectives of the production of highest yield hardwood pulps and their utilization in printing and writing papers and also corrugating and other boards. Of special interest was the introduction of hardwoods into products dependent on softwood groundwood pulp.

Since the times of the first commercial trial of cold soda pulp at the Green Bay Paper & Pulp Co., Green Bay, Wis., in 1953 on corrugating board and the first full-scale commercial production of bleached cold soda pulp at the Gould Paper Co., Lyons Falls, N. Y., in 1956 for use in printing and writing papers, the number of cold soda installations has grown quite spectacularly. There are now about 15 cold soda pulp mills in operation or under construction in the United States, Europe, Australia, and South America. All these installations are integrated with mills producing either newsprint, or printing, writing, and tissue papers, or corrugating and food boards.

SCOPE OF THE REPORT

This report gives the results of a pilot plant investigation of a cold soda pulping system featuring low power consumption for a well-defibered pulp with a high freeness. The report covers the following:

1. Discussion of certain aspects of the cold soda pulping process, including available batch and continuous systems.
2. Presentation and discussion of cold soda pulping data for the low-power system and comparisons with other cold soda systems and various mechanical and chemical pulping processes.
3. Brief mention of bleaching tests and general applications of cold soda pulps.

GENERAL COMMENTS ON COLD SODA PULPING

Definition and Application of Process

The cold soda pulping process can be defined as a two-stage process involving (a) the treatment of wood chips or other fibrous materials with a relatively strong alkaline reagent, usually caustic soda, at room temperature with natural or forced penetration, and (b) simultaneous or subsequent defibering or fiberizing by mechanical action. Thus, this process is a type of semichemical pulping and has been identified as cold soda semichemical (CSSC) pulping (*3*).

The defibered cold soda pulps may be refined to develop papermaking properties following the defibering or may be partially or completely refined as part of the defibering stage. The pulp can also be bleached, usually before final refining.

The process has had greatest application with the temperate-zone hardwoods because of the great interest in utilizing these abundantly available materials and their now proved suitability for use by this process. However, softwoods, although less reactive, may be used, and agricultural fibers, grasses, and other annual plants have also been found to make useful pulps.

The procedures and equipment used in the impregnating and defibering stages of cold soda pulping cover a wide range (*2*) and certain of these are discussed briefly below, including the methods used in the present investigation.

Basic Procedural Aims

In applying the cold soda process certain basic aims have influenced the development of the various systems, as follows:

1. Maximum exposure of fibrous surface to the treating chemical during the impregnation.
2. Maximum flexibility of chemical concentration and reaction time.
3. Uniform impregnation of the fibrous material with respect to chemical concentration and distribution.
4. Minimum cutting or other degrading mechanical damage to the fibers in defibering.

E. R. Gremler, Technical Director, Pandia Division, The Black-Clawson Co., and J. N. McGovern, Chief Process Engineer, Parsons & Whittemore, Inc.

A variety of cold soda pulping systems have been developed to meet these aims. These are discussed below ahead of the results of the low-power system description.

Impregnation Stage

Batch Methods. The simplest impregnation system involves the natural penetration achieved by steeping chips in a caustic soda solution. Complete chemical penetration of normal hardwood chips is approached in about two hours. Shredding accelerates the chemical penetration, and high moisture content in the chips is also helpful. The disadvantages of this batch method are the relatively large size of the reaction vessel and the longer chemical exposure of the outside of the chip than the inside. Relatively high power has been reported as necessary to defiber the chips, namely 20 to 30 hp. per ton per day. Relatively high chemical concentrations are also required (25 to 75 g.p.l.) to give the driving force necessary for natural penetration.

To accelerate and improve the uniformity of liquor penetration of the chips, hydraulic or gas pressure has been used in pressure vessels. The penetration time can thus be reduced from 2 hr. to about 30 min., but, essentially, this method has the same disadvantages as atmospheric impregnation.

Continuous Methods. To overcome the disadvantages of batch operation, continuous steeping of normal or shredded chips is employed in several cold soda pulping systems. Submerged conveyors, live bottom tanks, or other continuous devices are used. A tendency toward unreacted chip cores has been reported, and the same fairly high defibering power, as explained above is required.

To improve impregnation over that obtained with natural penetration, several types of presses have been utilized. In some cases, the press is used to breakdown or split the raw wood chips and expose more fiber surface to the chemical. In other cases, chemical on the chip surface from showers or presteeping is forced into the wood as the press splits and compresses the chip. Chips leaving the compression zone may be immediately submerged in the caustic soda solution and will then absorb the liquor like a sponge. The action may be repeated in two or more presses with a variable retention time between compressions. The final press also provides initial defibering of the chips, as well as dewatering for liquor recycling and chemical recovery.

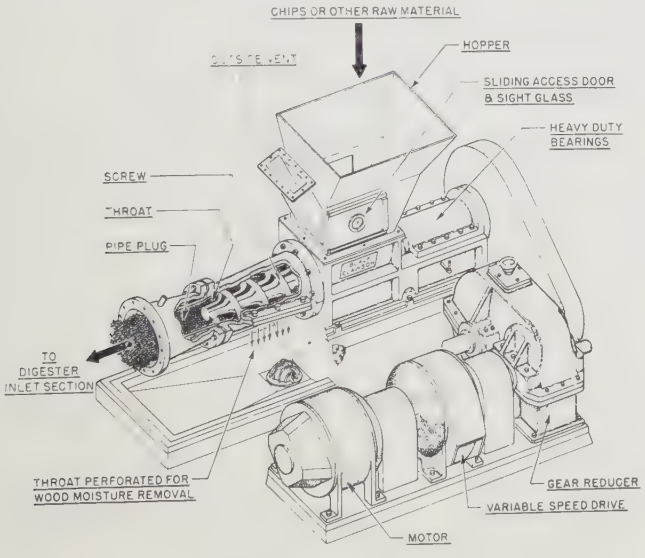

Fig. 1. Feeder press

In the latter system the treatment is relatively mild in both presses. Because the treating chemical is present, power input and wear are reduced. Two-press impregnation with intermediate retention was employed in the present work.

Disk refiners of the single- and double-disk type are most commonly used for defibering. They are normally screw fed at relatively high density. The defibering may be accompanied by refining, and the operation may be conducted in one or more stages. The power requirements for defibering cold-soda treated chips in the conventional disk mill ranges from 20 to 30 hp. per ton per day in producing high freeness pulps. Additional power of up to 30 hp. per ton per day may be used in refining. The presses as described under the impregnation stage will accomplish a partial defibering with relatively low power.

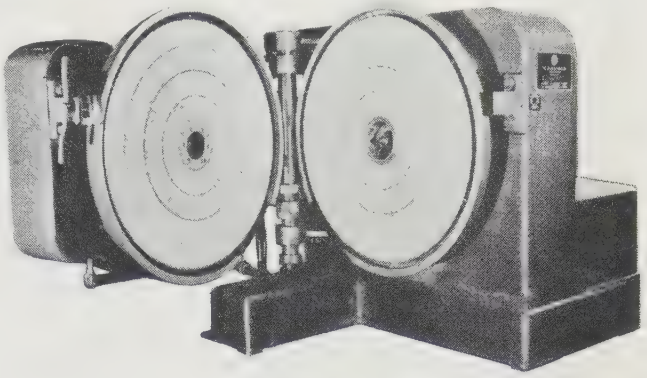

Fig. 2. Chemifiner disk mill

Defibering Stage

A newly designed defibering machine operating on a well-developed principle, the Chemifiner, was used in this investigation. This machine accepts impregnated chips of 30 to 35% consistency. It functions as follows: Chips are screw fed into the center of two plates or disks rotating at the same speed and in the same direction. The centers of these plates are offset and, for that reason, there is a speed difference at a given point. The plates have small pyramid-type stellite teeth, which hold the material. The speed differential at a given point between the plates disrupts the bundles into fibers, and curls them. The plates can not touch, and all the energy is used in defibering the pulp. Due to this fact and due to the high consistency of the stock, the Chemifiner uses less power than that required by other defibering machines operated conventionally for producing defibered, unrefined pulps.

The absence of excess chemical and moisture is necessary to the operation of this special disk mill. The press impregnation and Chemifiner defibering have been combined into a cold soda pulping system described previously (*4*).

DESCRIPTION OF TESTS

Fibrous Materials

A number of woods and bamboo were used in the cold soda pulping tests as follows:

1. Aspen from the Lake States area of the U. S.
2. Sweetgum from the southern area.
3. A hardwood mixture from the northeastern area comprising 60% birch species, 28% maple species, and 12% mixed hardwoods.
4. Yellow birch from the northeastern area.
5. Oak from the southeastern area.
6. Bamboo (*Bambusa polymorpha*) from Burma.

Experimental Equipment

The results for the low-power CSSC system were obtained in pilot-plant equipment of small commercial size, having a capacity, on a 24-hr. basis, of 2 tons, with the exception noted below. The feeder press of the system, which acts also as the second press in the simulated continuous operation, has 7.5-in. diameter and is of the type shown in Fig. 1. The special disk mill, the Chemifiner, is 20-in. in diameter and is of the

type shown in Fig. 2. This equipment is operated in the pilot plant of the Brown Co., Berlin, N. H.

One series of runs was made in laboratory-size equipment consisting of a 2-in. feeder press and an 8-in. Chemifiner with horizontally mounted plates.

Cold Soda Pulping Procedure

The cold soda pulping procedure is described below. The variable conditions are given in the accompanying tables of conditions and results.

A typical cold soda pulping run was made as follows: 80 lb. (ovendry) of moist chips were sprayed with caustic soda solution of treating strength to give a liquor: wood ratio of 1.8 to 2:1 and held in the chip-feeding hopper for 5 min. The pretreated chips were then fed through the first feeder press in a time span of 10 min. The average preimpregnation time was thus 10 min.

The chips leaving the press were immediately sprayed with a dense shower of caustic soda solution of treating strength and dropped into a container. The liquor:solid ratio in the container was in the range of 8:1 to 10:1. After 10 min. average time in the retention container, the excess liquor was drained off and the chips then passed through the feeder press for a second pass. This handling gave an average total retention time of 20 min. The liquor samples expressed in the first and second passes plus the liquor drained from the retention container were collected and re-used two to eight times.

The partially defibered chips from the second feeder press were collected and the defibering completed in the Chemifiner within the next 15 min. The material from the second press had a solids content of about 50 to 60%, which was adjusted to 30% by the addition of water before entering the special disk mill. A small amount of low-pressure steam was added to the Chemifiner to raise and maintain the temperature during the defibering process at 160 to 170 F. The defibered pulp was finally brushed out lightly at a low consistency (3 to 5%) in a disk refiner. After this the pulp was washed and screened.

In one run the material from the second press was divided into two parts and one portion defibered and refined in a small disk refiner and the other defibered as described above followed by a slight refining action in the disk refiner.

Test Procedures

Pulp yield and chemical comsumption were tested by conventional methods. The power consumption data for each run were determined from the ammeter readings and time of run for the feeder press and recording wattmeter readings for the Chemifiner.

The experimental pulps were tested for strength by a ball mill procedure using somewhat modified TAPPI pulp testing procedures. Several outside-made cold soda and full chemical pulps used for comparison were also tested by this procedure.

Several of the experimental cold soda pulps were also tested in outside laboratories using standard TAPPI methods for comparisons as noted subsequently. The various results as obtained above are discussed below and are given in the accompanying tables of data.

DISCUSSION OF RESULTS

Comparison of Several Cold Soda Systems Using Aspen Wood

A comparison of pulping results and pulp strength properties for several cold soda pulping systems using aspenwood is given in Table I. The comparisons are made for pulps at their initial, defibered freeness and at freeness values of 450 and 250 ml. The systems included the following:

1. Batch atmospheric steeping and conventional disk defibering (Table I, no. 1).
2. Batch pressure impregnation with caustic soda of two concentrations and conventional disk defibering (Table I, nos. 2 and 3).
3. Continuous impregnation and partial defibering in a roller press and conventional disk defibering (Table I, no. 4).
4. Continuous impregnation with two screw feeder presses with intermediate retention and defibering in a Chemifiner (low-power system) (Table I, no. 5).

The following observations can be made regarding Table I:

1. The basic steeping process gave a strong cold soda pulp with consumption of 7.5% NaOH and 27.5 hp. per ton per day. The power consumption for the high freeness value of 730 ml. is quite high.

Table I. Comparison of Aspen CSSC Pulps Made by Several Pulping Systems

Treating conditions		*Pulping results*				*Pulp strength properties*		
NaOH concn., g./l.	*Time, min.*	*NaOH consumed, %*	*Power used, hp./ton/day*	*Pulp condition*	*Freeness (C.S.), ml.*	*Bursting strength, pt./lb./ream[a]*	*Tearing resistance, g./lb./ream[a]*	*Tensile strength, m.*
			1. Batch Steeping and Disk-Mill Defibering[b]					
50	120	7.5	27.5	Defibered	730	0.13	0.99	1200
			37.0[c]	Beaten[d]	450	0.47	0.90	5000
			43.5[c]	Beaten[d]	250	0.72	0.76	6750
			2. Batch Pressure Impregnation and Disk-Mill Defibering[b]					
25	20	2.7	70	Defibered	595	0.17	1.09	1900
			74.5[c]	Beaten[d]	450	0.28	1.03	3300
			82[c]	Beaten[d]	250	0.43	0.88	5000
			3. Batch Pressure Impregnation and Disk-Mill Defibering[b]					
50	20	6.0	29	Defibered	690	0.12	0.90	1450
			43[c]	Beaten[d]	450	0.39	1.00	4300
			56[c]	Beaten[d]	250	0.64	0.85	6200
			4. Continuous Roller-Mill Impregnation and Disk Defibering[b]					
40	2–3	5.5–6.5	15	Defibered	540	0.28	1.22	3120
			17.5[c]	Beaten[d]	450	0.37	1.12	4410
			24[c]	Beaten[d]	250	0.65	0.85	6500
			5. Continuous Feeder Press Impregnation and Chemifiner Defibering					
23	20	5.5	10	Defibered	660	0.11	0.73	2340
			14[c]	Beaten[d]	450	0.50	0.85	5200
			17.5[c]	Beaten[d]	250	0.72	0.81	6700

[a] Ream of 500 sheets, 25 × 40 in.
[b] Data from Brown, K. J. and Monsson, W. H., *Tappi* 39, No. 8: 592–599 (Aug., 1956).
[c] Estimated as based on initial consumption plus 2.5 hp./ton/day for every 10 min. beating.
[d] Valley beater according to TAPPI test.

Table II Effect of Laboratory-Scale Defibering on Strength Properties of Sweetgum CSSC Pulps

Treating conditions				Freeness	Pulp strengths	
NaOH concn., g./l.	Time, min.	Defibering machine	Refining machine	(C.S.), ml.	Burst factor	Tear factor
		Steeping and Disk-Mill Defibering				
25	120	8-in. Disk mill	8-in. Disk mill	280[b]	53	116
		Steeping and Chemifiner Defibering				
25	120	8-in. Chemifiner[a]	8-in. Disk mill	280[b]	75	160
		Feeder Press Impregnation and Chemifiner Defibering				
25	20	8-in. Chemifiner	8-in. Disk mill	280[b]	75	160

[a] Pressed before Chemifiner.
[b] Interpolated.

2. The pressure impregnation system produced a weak pulp with an extremely high power consumption using a low chemical application of 2.7% and a stronger pulp with chemical amounting to 6.0%, but still with a high power requirement.

3. The roller press system gave a pulp of good strength with a low power consumption and a moderately high estimated chemical consumption. The estimated time in the roller press was very short, 2 to 3 min.

4. The feeder press—Chemifiner (low-power) system gave a strong pulp with low concentration and consumption of NaOH and the lowest power consumption of all the systems above. Thus, this system appeared to give pulping and pulp strength results equal to or better than the other processes but with unusually low power consumptions.

The favorable results powerwise from the low-power system above were attributed to preliminary chip disintegration and primary defibering in the feeder presses in the presence of caustic soda and the use of a high-density and high temperature with the special rubbing, fiber-on-fiber action.

The same trends toward reduction in power consumption with preliminary reduction in particle size of the treated chips and defibering at high consistency have been reported for neutral sulfite semichemical pulping (*1*).

Comparison of Laboratory Disk and Chemifiner Defibering

Results of laboratory-scale tests comparing an 8-in., single-disk mill and an 8-in. Chemifiner are given in Table II. In these brief tests it was found that a pulp with appreciably higher bursting and tearing strengths was obtained by using a combination of a laboratory Chemifiner for defibering and a laboratory disk mill for refining in comparison with conducting both the defibering and refining in the disk mill. It is conjectured that the particular disk mill employed in the test seriously cut or otherwise degraded the fibers in reducing the caustic-treated material to a pulp for refining. Thus, there was a freeness drop without refining. This illustrates the importance of a fiber-on-fiber action during defibering.

When sweetgum chips were given a short treatment involving a laboratory feeder press, and the defibering of the treated material was again conducted in the small Chemifiner, the results then were the same as with the steeping—Chemifiner system. This is another indication of the efficiency from a time standpoint of the feeder-press impregnation method compared with steeping, i.e., 20 versus 120 min. In addition, there is the advantage of the contribution that the press impregnation makes to reducing the overall power consumption.

Table III. Screen Analysis of Two Low-Power CSSC Pulps from a Northern Hardwood Mixture[a]

Treatment[b] NaOH concn., g./l.	Power consumption, hp./ton/day	Screen analysis[c] Retained on 20-mesh, %	35-mesh, %	105-mesh, %	150-mesh, %	Passing 150-mesh, %
35	12	15	25	21	20	19
24	12.5	8	16	24	22	30

[a] 60% birch, 28% maple, 12% other mixture.
[b] Treating time = 20 min.
[c] Bauer-McNett Classifiner.

Table IV. Comparison of Softwood Groundwood and Book-Grade Hardwood Cold Soda Pulps

Freeness (C.S.), ml.	Burst factor	Tear factor	Strength value[a]	Bulk (Kerosine), cc.	Brightness, %	Opacity %
			Softwood Groundwood Pulp			
255	27	50	104	297	..	94
130	32	59	123	152	..	94
90	48	70	166	138	68	94
			Batch Cold Soda Pulp from Northern Hardwood Mixture			
220[b]	35	53	123	114	46	91
			Low-Power Cold Soda Pulp from Northern Hardwood Mixture			
615	24	55	103	188	39	93
325[b]	48	77	173	104	39	92

[a] 2 × Burst factor plus tear factor.
[b] Pulp processed in beater.

Characteristics of Low-Power CSSC Pulps

Screen Analysis. Two high-freeness, low-power cold soda pulps made from a northern hardwood mixture with two concentrations of caustic soda treating solution 35 and 24 g.p.l., were fractionated, and the resulting screen analyses are given in Table III.

The pulp made with 35 g.p.l. caustic soda solution showed an unusually even distribution of fibers within the various fractions. It resembled groundwood pulp in its percentage retentions as intermediate fractions, but differed in having a considerably lower amount of fines passing the 150-mesh screen and a somewhat higher percentage of coarse fibers retained over on the 20-mesh screen.

The pulp made with the lower concentration of treating alkali, 24 g.p.l., showed a decrease in coarse and an increase in short fibers because of the less flexible material going to the defibering machine. The pulp was approaching a groundwood pulp in its screen analysis.

If both pulps had been refined to a lower freeness value, there undoubtedly would have been a shift toward an increasing percentage of fines. The power consumed in pretreatment and defibering the two pulps above was substantially the same.

Table V. Comparison of Strength Properties of Hardwood Cold Soda and Chemical Pulps

Freeness (C.S.), ml.	Beater test values Burst factor	Tear factor	Strength value[a]	Folding endurance, folds
		Northern Hardwood Cold Soda[b]		
440	54	94	202	..
		Northern Hardwood Sulfite		
375	91	124	306	602
		Northern Hardwood Sulfate		
400	117	152	386	800
		Yellow Birch Cold Soda[c]		
400	93	133	319	160
		Yellow Birch Sulfite		
390	105	122	332	600

[a] 2 × Burst factor plus tear factor.
[b] Conditions: airdry wood; 35 g.p.l. treating solution; ball-mill processed.
[c] Conditions: green wood; 35 g.p.l. treating solution.

Table VI. Comparison of Strength Values of Hardwood Kraft and Cold Soda Pulps

Freeness (C.S.), ml.	Strength values[a] Hardwood[b] kraft	Strength values[a] Birch cold soda	Folding endurance Hardwood kraft, double folds	Folding endurance Birch cold soda, double folds
650	130	180	..	25
600	225	225	120	45
500	325	280	450	100
400	385	325	800	160
300	420	350	1070	240
200	430	360	..	..

[a] 2 × Burst fact plus tear factor.
[b] Northern hardwood mixture.

Comparison of Properties, Hardwood CSSC with Softwood Groundwood Pulps. The properties of a commercial softwood groundwood pulp made in a range of freeness and cold soda pulps made by two systems from a northern hardwood mixture are compared in Table IV. One cold soda pulp was made according to a batch, pressure impregnation system and the other by the low-power system.

The softwood groundwood showed typical increases in strength values and a decrease in bulk with decrease in freeness. The opacity did not change in this series of tests. The lowest-freeness groundwood pulp would probably be considered a booktype pulp and the intermediate-freeness pulp a news-grade pulp.

The batch cold soda pulp appeared to be in the range of strength properties of a news-grade pulp. This pulp had, however, the high freeness and somewhat low bulk and opacity characteristic of semichemical pulps.

The low-power cold soda pulps, the data of which are presented in Table IV at two freeness levels, had strength properties covering the groundwood book- and news-grade range, although the pulps had exceptionally high freeness values. These pulps were also typically low in bulk, but they were only slightly lower in opacity in these tests than the softwood groundwood pulps, but at lower brightness.

The low-power cold soda pulp was considerably stronger and less bulky than the batch cold soda pulp used for comparison in this investigation.

The possibilities of producing hardwood cold soda pulps covering a range of properties in the softwood groundwood range through manipulation of the treating, defibering, and refining conditions is evident from the test results above.

Comparison of Hardwood Cold Soda, Sulfite and Sulfate Pulps. The results of strength tests on cold soda and commercial sulfite and sulfate pulps from a northern hardwood mixture and yellow birch are compared in Table V. The cold soda pulps were made by the low-power system and the sulfite and sulfate pulps were conventional bleachable grades.

In comparing the respective pulps from the northern hardwood mixture, it is noted that the bursting and tearing strengths at the same general feeeness level increase as the process changes from cold soda to sulfite to sulfate or kraft. It is estimated that the strength value (twice burst factor plus tear factor) for the cold soda pulp would have been 20% higher if green wood had been used and the pulp had been processed in a beater. Thus, the cold soda pulp could be expected to have a strength value about 75% of that for sulfite pulp from the same wood mixture.

A low-power cold soda pulp made from yellow birch showed exceptionally high strength properties, as shown in Table V. Its bursting and tearing strengths and strength value approached closely these properties for a sulfite pulp from the same wood at an intermediate freeness level of about 400 ml. The sulfite pulp from 100% birch had a strength value about 10% higher than that from the northern hardwood mixture (60% birch), as would be expected from the recognized superiority of birch as a hardwood pulpwood.

Although the folding endurance of the birch cold soda pulp was high for its type of pulp, its level for this property was only about 25% of that of its sulfite pulp counterpart. This difference is due to the fact that the cold soda pulp has its original lignin content.

A comparison is shown in Table VI of the strength and folding endurance values of the birch cold soda and northern hardwood sulfate pulps described in Table V. The values are given at different freeness levels from strength versus freeness curves. This tabulation shows that the birch cold soda pulp actually had strength values at high freeness levels comparable with those for the kraft pulp, although the kraft pulp had higher values after processing. However, the cold soda pulp had a folding endurance that was only 25% of that of the sulfate pulp.

The above results indicate the possibility of substituting cold soda pulps for hardwood chemical pulps under certain circumstances.

Comparison of Low-Power Cold Soda Pulps from Different Hardwoods and Bamboo

A comparison of the results of the pulping of several hardwoods and bamboo by the low-power cold soda system is given in Table VII. The pulps were defibered to a freeness range of 660 to 735 ml. with low-power consumptions of 10 to 13 hp. per ton per day.

Among the several hardwoods given in Table VII, the yellow birch gave the strongest cold soda pulp, followed in decreasing order by the northern hardwood mixture, aspen, and oak. The pulps from the northern hardwood mixture and the oak were made from dry wood, which, according to other tests, may have been given 10% lower strength values than green wood. The aspen pulp was made with a low alkali concentration, which accounted for its relatively low strength in comparison with the northern hardwood mixtures and birch.

The oak CSSC pulp was quite weak, although a reasonably

Table VII. Results from Application of Low-Power CSSC Process to Several Woods and Bamboo

Fibrous material	Treating[a] NaOH concn., g./l.	Pulp yield, %	Power consumption, hp./ton/day	Pulp condition	Freeness (C.S.), ml.	Pulp strength properties: Burst factor	Tear factor	Strength value[b]	Tensile strength, m.
Aspen	23	86	10	Defibered	660	8	89	105	2300
			...	Processed[c]	450	36	94	166	5200
Birch	35	86	13	Defibered	685	25	71	121	1500
			...	Processed[e]	530	55	110	220	3650
Northern hardwood mixture[d]	35	86	12	Defibered	660	26	76	128	2050
			...	Processed[e]	440	54	94	202	5500
Oak[d]	32	85	8.5	Defibered	735	22	34	76	520
			...	Processed[e]	505	36	71	143	2750
Bamboo[d]	31	89	11	Defibered	705	34	114	180	1200
				Processed[e]	410	60	161	280	2700

[a] Treating time = 20 min.
[b] Strength value = 2 × burst factor plus tear factor.
[c] Pulp processed in beater.
[d] Airdry material.
[e] Pulp processed in ball mill.

high treating liquor concentration of 35 g.p.l. was used. A higher concentration was indicated as being desirable.

The variation in cold soda pulp strengths with wood species demonstrated in Table VII is not unusual and has been reported in numerous publications of the Forest Products Laboratory, Madison, Wis., on cold soda pulps from a large number of woods. The range of properties with respect to wood species indicates the possibility of a certain control on end results by selection of wood species.

The cold soda pulping of bamboo by the low-power system was investigated and the results are also given in Table VII. This material was found to react quite similarly to hardwoods, just as it does in full chemical pulping. The bamboo cold soda pulp, however, was distinguished by its exceptionally high tearing strength. This is in agreement with its fiber length, which is of the order of 3 mm. as compared with 0.8 to 1.5 mm. for the hardwoods. The bursting strength of the bamboo cold soda pulp was in range of aspen and birch pulps. Therefore, this pulp had a high strength value. Folding tests were not available. The results on bamboo indicated great potentialities for cold soda pulps made from it, which would be especially important if this would lead to its use as a groundwood-type pulp.

Bleaching of Low-Power Cold Soda Pulp

A quantity of low-power cold soda pulp was made for bleaching from a northern hardwood mixture (yellow birch, 33%; maple, 39%; and beech, 28%) using a caustic soda treating solution of 35 g.p.l. concentration and other conditions as described previously, including a 20-minute impregnation. The pulp was made with a chemical consumption of 9% and a power consumption of 12.1 hp. per ton per day, based on airdry pulp. The defibered pulp had a freeness of 675 ml. (C.S.) and a brightness (G.E.) of 42%.

The pulp above was bleached with hydrogen peroxide after a sulfuric acid wash. Sufficient acid was added to bring the acidity to pH 2.5 to 3, held for 5 min. at 23°C., and washed.

The acid-washed pulp was bleached with 1.5% hydrogen peroxide (buffered with 0.05% Epsom salts, 5% sodium silicate, and 0.8% caustic soda) with a retention time of 300 min. at 80°C.

The brightness of the bleached pulp was 70.5%. The skrinkage was 7.6%. Thus, the low-power cold soda pulp made as above responded normally to the peroxide bleaching.

APPLICATION OF COLD SODA PULPS

It has been shown from the results of the present investigation that cold soda pulps made with the low-power system are comparable with those made by other methods. Therefore, it would be expected that they could be used in the many paper and board products presently consuming cold soda pulps or having potentials for such use. Some of these uses are outlined below:

1. General groundwood and hardwood chemical pulp substitutes or supplements.
2. Filler pulps for papers and boards.
3. Newsprint and printing and writing papers.
4. Toweling and tissue papers.
5. Food and other bleached boards.
6. Corrugating board.
7. Insulating board.

CONCLUSIONS

Investigations of a continuous cold soda pulping system comprising short feeder press impregnation and defibering in a special disk refiner showed that:

1. Well-defibered pulps are produced at high freeness with low-power consumption. These pulps are equal or superior in strength properties to pulps made by the basic steeping and conventional disk refiner systems before and after refining.

2. Pulps are made with low-power consumption having properties ranging from those similar to softwood groundwood to those approaching hardwood chemical pulps (except for low folding endurance), depending on the fibrous raw material and process conditions.

3. Bamboo makes a strong cold soda pulp with an especially high tear factor.

LITERATURE REFERENCES

1. Aflenzer, Friederich A., *Tappi* 37, No. 3: 90–96 (March, 1954).
2. McGovern, J. N., *Tappi* 42, No. 2: 158A–161A (Feb., 1959).
3. McGovern, J. N., "The College Textbook of Pulp and Paper Manufacture," Vol. 1, Chap. 11, TAPPI (1958).
4. *Paper Industry* 40, No. 11: 739–740 (Feb., 1959).

The Use of the Product of Burst and Tear Values as an Index to Fiber and to Refiner Evaluation

JOHN R. FANSELOW and
JOHN L. FANSELOW

The paper industry is still in need of a more satisfactory index to evaluate the strength of cellulose pulp as well as to evaluate the performance characteristics of refiners used to modify pulp strength. This discussion examines the use of the product of values for burst and tear, or for tensile and tear, as an index to pulp strength as well as a means for characterization of performance of pulp refiners. From this discussion it appears that one may draw the following conclusions: (1) the product of values for the two strength attributes relates these values in one index which characterizes pulp strength potentials; (2) the use of this product as an index removes the complications envolved in the comparisons of pulps with divergent tendencies to develop burst or tensile vs. retain resistance to tear; (3) the use of this product as an index minimizes the problem of correlation between the results of laboratory evaluation and performance of the pulp in the mill equipment; (4) it serves as a tool by means of which the performance characteristics of different refiners may be evaluated; (5) it indicates that most reliable pulp strength evaluation may be obtained through the use of a refiner whose performance does not depend upon close clearance between refiner elements; and (6) if the product of the two attributes is to be used as an index for pulp strength evaluation, the majority of pulps used in making paper need be refined to but one degree, i.e., to a degree which corresponds to Canadian Standard freeness between 550 and 300, or which will give a handsheet density between 0.70 and 0.80 g./cc.

In spite of the large amount of work that has been done on the age-old problem of cellulose fiber strength evaluation, the literature in the field indicates that the industry is still looking for a more satisfactory index. Of equal need is a suitable index by means of which to evaluate the characteristics of the refiners used to modify pulp strength.

The two objectives are so interrelated that one of the most troublesome phases of the problem has been that of separating the impact of the refiner from that of the fiber. For that reason it seems essential to discuss not only the evaluation of pulp strength but also the evaluation of the characteristics of the refiner.

So often in a situation like this there is the inclination to look for some new test. For this discussion we would like to examine the possibilities of making more effective applica-

John R. Fanselow, Associate Professor, Department of Paper Technology, Western Michigan University, Kalamazoo, Mich. John L. Fanselow, student at Western Michigan University.

tion of the results of two or three of the long-established tests, i.e., burst or tensile and tear.

We have selected burst or tensile because either of these measures a commonly used attribute of pulp and is considered by many to indicate the degree of fiber bonding in paper made from the pulp. We select resistance-to-tear because this measures a commonly used attribute of pulp and is considered by many to indicate the residual strength in the pulp fibers. An evaluation of the two attributes is generally thought to be essential to the evaluation of the strength characteristics of a pulp. A measure of the influence of the refiner in the development of these attributes in pulps should serve as a means for characterizing the action of the refiner.

For some types of papers burst or tensile receive more emphasis than does resistance-to-tear. For other papers resistance-to-tear is of more importance than burst or tensile. However, for a wide range of papers the two attributes receive more nearly equal emphasis. Except in the cases where pronounced emphasis is to be placed upon one attribute or the other, the best index to pulp strength must give weight to the two attributes.

We are, of course, all familiar with the manner in which the values for tear decrease as the values for burst or tensile are increased through refining or mechanical treatment of cellulose pulp. To complicate the evaluation of the strength characteristics of a pulp, the relationship between the increase in burst or tensile and the accompanying decrease in tear differs not only from pulp to pulp, but also from refiner to refiner and with variation in mechanical condition of the refiner or with variation in method of operation of a refiner.

In addition to these complications, much of the confusion in the evaluation of pulp strength arises from the lack of agreement on reference point and on the relative weighting to be given to the results of the various measurements. As a reference point should one use refining time, refiner power, pulp freeness or hand sheet density? To what degree should the pulp be refined for evaluation? What type of refining equipment should be used? What relative weighting is to be given to the values for burst, tensile, tear, etc.? How does the laboratory evaluation relate to the performance of the pulp in the mill equipment?

We have all seen the pulps which readily develop high values for burst or tensile, but which have low resistance to tear. We have also encountered the pulps which have high resistance to tear, but exhibit low values for burst or tensile. We have also seen pulps which possess not only the potential to develop high values for burst and tensile, but which also retain high resistance to tear while the fiber bonding attribute is being developed by the refiner. How can one equate the two types of attributes to better evaluate the strength characteristics of these various types of pulps?

We have all seen the refiner which develops burst, tensile, and fold in pulps at relatively low cost in power and at high refiner capacity, but at high cost in the reduction in resistance to tear. We have seen refiners arranged in series and in parallel. We have used low-speed and high-speed refiners. We have used refiners with narrow bars, wide bars, and without bars. How can we evaluate the characteristics of these combinations?

We are, of course, not going to provide the answers to all of the foregoing questions. It is our hope, however, that through this discussion we may indicate a more effective application of the results of some of the established measurements of pulp attributes as a means by which we can better answer some of the questions.

For this discussion we would like to examine the possibilities of using the product of the values for burst and tear or for tensile and tear as an index for evaluating not only the strength characteristics of cellulose fiber pulps, but also for characterizing the action of pulp refiners. For this purpose we may use either pair of values. They have very similar characteristics and lead to similar, if not identical, conclusions. Where the data are available we will use both. For the most part we will use only the product burst $\times$ tear because these values are more extensively reported in the literature and because it costs less work in the laboratory to measure burst than to measure tensile. Were the available data as extensive we would prefer to use the values for tensile.

This thesis is not being discussed as though it were a new discovery. Others have used this product of values for burst and tear while others have used more complex combinations of the two attributes for purposes similar to our objective.

Likewise, this thesis is not being developed as a fundamental approach. The product of the two values cannot be any less empirical than either of the values used in its calculation.

In spite of all the foregoing limitations, let us proceed to examine some of the features of this simple product of burst and tear ($B \times T$) or of tensile and tear ($T \times T$) as an index for the evaluation of the strength characteristics of a few representative cellulose fiber pulps and for characterization of the action of a few types of refiners.

PULP STRENGTH EVALUATION

From the reciprocal relationship between the curves for burst or tensile and tear which results from plotting the

Table I. Development of Strength Attributes of Pulps
Valley Beater and Standard Disintegrator

	Canadian Standard freeness, ml.						
	Valley beater				*Standard disintegrator*		
	600	*500*	*400*	*200*	*600*	*500*	*400*
	Kraft Fiber—Dry, Bleached						
Sheet density, g./cc.	0.64	0.69	0.71	0.75	0.58	0.61	0.64
Burst factor	0.94	1.15	1.24	1.34	0.68	0.84	0.93
Tear factor	1.75	1.43	1.30	1.19	2.32	2.05	1.87
Tensile, lb./15 mm.	18.6	22.7	23.1	26.2	13.8	16.6	18.2
	Sulfite Fiber—Wet, Bleached						
Sheet density, g./cc.	0.69	0.78	0.81	0.85	0.69	0.75	0.75
Burst factor	0.83	1.06	1.18	1.25	0.72	0.88	0.96
Tensile, lb./15 mm.	18.5	23.6	26.0	27.4	17.3	19.4	20.0
Tear factor	1.02	0.84	0.77	0.74	1.15	1.03	0.97
$B \times T$	0.85	0.89	0.91	0.93	0.83	0.91	0.93
$T \times T$	18.9	19.8	20.0	20.3	19.9	20.0	19.4
	Sulfite Fiber—Dry, Bleached						
Sheet density, g./cc.	0.64	0.69	0.75	0.78	0.62	0.66	0.9
Burst factor	0.56	0.76	0.87	1.00	0.52	0.64	0.70
Tensile, lb./15 mm.	15.2	18.2	20.0	21.4	13.2	15.2	16.4
Tear factor	1.39	1.17	1.08	1.00	1.50	1.37	1.27
$B \times T$	0.78	0.89	0.94	1.00	0.78	0.89	0.89
$T \times T$	21.1	21.3	21.6	21.4	19.8	20.7	20.8

Table II. Typical Burst and Tear Values

	Canadian Standard freeness, ml.					Pulp strength rating		
	600	500	400	300	200	Burst	Tear	$B \times T$
			Pulp A					
Burst factor	0.40	0.55	0.67	0.78	0.86	6		
Tear factor	3.13	3.40	2.92	2.47	2.10		1	
$B \times T$	1.25	1.87	1.96	1.93	1.81			3
			Pulp B					
Burst factor	0.87	0.99	1.07	1.14	1.18	5		
Tear factor	2.05	1.75	1.57	1.44	1.40		3	
$B \times T$	1.78	1.73	1.68	1.64	1.65			4
			Pulp C					
Burst factor	0.95	1.08	1.17			4		
Tear factor	2.21	1.94	1.81				2	
$B \times T$	2.10	2.10	2.12					2
			Pulp D					
Burst factor	1.52	1.70	1.75			1		
Tear factor	1.48	1.35	1.31				4	
$B \times T$	2.26	2.29	2.29					1
			Pulp E					
Burst factor	0.96	1.09	1.15			3		
Tear factor	0.82	0.76	0.72				5	
$B \times T$	0.79	0.82	0.83					6
			Pulp F					
Burst factor	1.12	1.24	1.30			2		
Tear factor	0.80	0.69	0.66				6	
$B \times T$	0.90	0.86	0.86					5

values of these attributes against "time of refining," "pulp freeness," or "handsheet density," one would expect some semblance of constancy in the product of the values for tear with either of the other two measurements over a substantial portion of the refining range. For pulps developed in the Valley beater (TAPPI Standard T 200 m-45), and evaluated in accord with TAPPI Standard T 205 m-58, there is, for the freeness range between approximately 600 and 200 Canadian Standard, or sheet density between approximately 0.65 and 0.80 g. per cc., a surprisingly high degree of constancy in this product.

When these same pulps are developed by the Standard disintegrator, over similar range of freeness, they display appreciably lower burst and tensile, but the resistance to tear at each freeness is sufficiently higher to make the products for tear with either of the other two measurements surprisingly close to those for the pulps developed in the Valley beater (see Table I). As with the beater there is a rather high degree of constancy for these products over the freeness range from 600 to 200 Canadian Standard. However, for these same pulps, refined under other conditions, the constancy of this product may not prevail, though there usually is a definite pattern.

At pulp freenesses above 600, or for sheet densities below 0.65 or 0.60, the values for tear may be irregular or not highly reproducible. At the other end of the freeness scale, i.e., at freeness values much below 200, or handsheet density values above 0.85 g. per cc., the values for burst and tensile, as well as for tear, show a tendency to drop with increasing degrees of refining. For either extreme in degree of refining the product of the two strength attributes does not behave in a manner that is useful to the thesis of this discussion.

In addition to the irregular behavior of the product of tear with either burst or tensile at the two extremes of refining, a few types of pulps require more drastic refining before their behavior fits the thesis of this discussion. These are the very high alpha-content pulps, alkaline cooked short fiber pulps or alkaline extracted pulps, cotton linters, and the more drastically dried sulfite or kraft pulps. For these pulps the sheet density at a given freeness is usually appreciably lower than for most pulps. For these special pulps in particular it appears that sheet density is a better reference point than pulp freeness for comparison of degree of refining.

These limitations in the behavior of the product of tear with burst or tensile have disguised its tendency to remain constant over the freeness range between 600 and 200, or sheet density between 0.65 and 0.85 g. per cc. These limitations, however, are not a serious deterrent to the applications of this product as an index. For most commercial paper production in which both burst and tear are important, the long fiber chemical pulps are refined to some degree within this range of freeness of sheet densities. Similarly, for pulp strength evaluation there is little need, if any, for examining the pulp at any degree of refining outside this range.

Under some conditions of refining the product of tear with either burst or tensile may increase slightly with progressive refining within the freeness range between 600 and 200. For other conditions of refining these products for the same pulps may decrease with progressive refining. Also, the product of burst or tensile and tear for a given pulp may be substantially different when the pulp is developed by different refiners or when developed under different conditions of refining with the same refiner.

The user of pulp is frequently confronted with the selection of one or two pulps from a list of strength tests similar to those shown in Table II. For the person making stock in which tear is of primary importance, he would probably rate pulp A near the top with pulp F near the bottom. Were he making glassine or waxing he would probably reverse the order of preference. If, however, he were making book or writing the choice would not be as simple.

The user would know that, in the case of the pulps having high resistance to tear and low burst, he could develop higher burst at a cost in tear reduction by using more power in the refiner. How, however, would the resultant burst and tear of this pulp compare with those pulps which have lower initial tear and higher initial burst or tensile? How can one equate the two strength attributes in these widely different pulps?

In such a situation, to determine the reduction in tear required to develop the desired burst, one may refine the pulp in the equipment to be used in the production development of the pulp. If, however, one could place confidence

Table III. Typical Range of Pulp Strengths

	Strength attributes			Canadian Standard freeness, ml. $B \times T$			$T \times T$		
	600	500	400	600	500	400	600	500	400
				Sulfite A Wet, Bleached					
Sheet density, g./cc.	0.76	0.80	0.83						
Tear factor	0.77	0.68	0.65						
Burst factor	0.76	0.92	0.99	0.59	0.63	0.64			
Tensile, lb./15 mm.	20.8	24.0	25.5				16.0	16.3	16.6
				Sulfite A Dry, Bleached					
Sheet density, g./cc.	0.72	0.77	0.80	..	..	..	..	..	..
Tear factor	0.99	0.85	0.78	..	..	..	..	..	..
Burst factor	0.54	0.73	0.85	0.53	0.62	0.66	..	..	..
Tensile, lb./15 mm.	16.7	21.1	22.6	..	..	..	16.5	17.9	17.6
				Sulfite B Wet, Bleached					
Sheet density, g./cc.	0.80	0.83	0.85	..	..	..	..	..	..
Tear factor	0.82	0.74	0.71	..	..	..	..	..	..
Burst factor	0.89	1.04	1.12	0.73	0.77	0.80	..	..	..
Tensile, lb./15 mm.	21.9	26.1	28.4	..	..	..	18.0	19.3	20.1
				Sulfite C Wet, Bleached					
Sheet density, g./cc.	0.77	0.80	0.83	..	..	..	..	..	..
Tear factor	1.01	0.89	0.84	..	..	..	..	..	..
Burst factor	0.89	1.07	1.15	0.90	0.95	0.97	..	..	..
Tensile, lb./15 mm.	21.4	25.0	26.7	..	..	..	21.6	22.3	22.4
				Kraft D Dry, Bleached					
Sheet density, g./cc.	0.65	0.71	0.74	..	..	..	..	..	..
Tear factor	1.58	1.32	1.21	..	..	..	..	..	..
Burst factor	0.88	1.11	1.22	1.39	1.47	1.48	..	..	..
Tensile, lb./15 mm.	20.0	23.8	25.7	..	..	..	31.6	31.4	31.1
				Kraft E Dry, Bleached					
Sheet density, g./cc.	0.67	0.70	0.77	..	..	..	..	..	..
Tear factor	1.76	1.49	1.36	..	..	..	..	..	..
Burst factor	1.01	1.27	1.39	1.78	1.89	1.89	..	..	..
Tensile, lb./15 mm.	22.2	26.1	27.8	..	..	..	39.1	38.9	37.8
				Kraft F Dry, Bleached					
Sheet density, g./cc.	0.64	0.68	0.77	..	..	..	..	..	..
Tear factor	2.21	1.94	1.81	..	..	..	..	..	..
Burst factor	0.95	1.08	1.17	2.10	2.10	2.12	..	..	..
Tensile, lb./15 mm.	20.2	22.9	24.4	..	..	..	44.6	44.4	44.2

in the product of burst and tear as an index to pulp strength he could calculate the residual tear for any degree of burst development. One must first, of course, have confidence in the behavior of this product as *such* an index.

The burst, tensile, and tear values for six rather representative pulps have been arranged in Table III in the order of increasing values for the product of burst and tear. These data are for wet and dry sulfite pulps as well as for kraft and sulfite pulps with rather different ratios between their respective values for burst, or tensile, and tear.

The strength measurements for pulp A wet and for pulp A dry are typical of the changes in strength attributes which take place in a pulp with drying to normal shipping moistures (80 to 90% air dry). When refined to a given freeness the sheet density and the burst or tensile for the dried pulp are lower than for the pulp before drying. The corresponding tear for the dried pulp, however, is usually increased enough by drying to result in a product for burst and tear essentially the same as that for the undried pulp. The constancy and the equality of the product of burst and tear, or tensile and tear, is not evident at the lower degrees of refining, but does display this characteristic at the higher degrees of refining, or at the degrees of refining which give the two forms of the pulp a more nearly common sheet density. The product of tensile and tear in this case is usually constant over a wider range of refining than is the product of burst and tear.

From the limited, though rather representative records in Table III one would infer from $B \times T$ that the sulfite pulp A did not suffer strength loss on drying, though the relationship between the two strength attributes was altered materially. To the user of pulp this relationship between the two attributes is important in the pulp's behavior. The potential strength in the pulp, however, was not lowered by the drying. With additional refining the same burst to tear values may be developed.

The use of the product of burst and tear indicates that sulfite pulps B and C were stronger than pulp A. It also indicates that the three kraft pulps were stronger than either of the sulfites, though for a given freeness the kraft pulps D and F have approximately the same burst and tensile as sulfite pulp C. Because of the higher residual tear in these kraft pulps they may have been refined more extensively to develop more burst or tensile. The product of burst and tear may be used to relate this exchange in tear for increase in burst or tensile.

THE EFFECT OF REFINERS AND OF REFINER OPERATION

The pulps referred to in the foregoing discussion were refined in the two types of refiners, i.e., the Valley beater and the Standard disintegrator (Table I). The difference in characteristics of the two refiners was displayed primarily in the difference, at a given pulp freeness, in ratio between burst or tensile and tear. With progressive refining the Standard disintegrator, with no close clearance between moving and stationary parts, did not develop burst or tensile or sheet density to as great a degree for a given reduction in pulp freeness as did the Valley beater, but it also did not reduce tear to as great a degree.

The records in Table IV compare the performance characteristics of a bar refiner and of a disk refiner with that of the Standard disintegrator. While these results should not be interpreted as being representative of bar nor of disk refiners, they do show that the performance characteristics of different

Table IV. Three Types of Refiners

	Standard disintegrator			Canadian Standard freeness, ml. Bar-Conical			Disk		
	600	500	400	600	500	400	600	500	400
Kraft Fiber—Dry, Bleached									
Sheet density, g./cc.	0.58	0.61	0.64	0.60	0.64	0.69	0.62	0.66	0.69
Burst factor	0.68	0.84	0.93	0.75	0.91	0.99	0.80	0.89	0.93
Tensile, lb./15 mm.	13.8	16.6	18.2	15.7	19.0	20.2	16.2	19.0	19.9
Tear factor	2.32	2.05	1.86	1.93	1.66	1.57	1.99	1.65	1.44
$B \times T$	1.58	1.72	1.74	1.45	1.51	1.51	1.59	1.47	1.34
$T \times T$	32.0	34.0	34.0	30.3	31.5	31.7	32.3	31.4	28.7
Sulfite Fiber—Wet, Bleached									
Sheet density, g./cc.	0.69	0.75	0.75	0.73	0.78	...	...	..	..
Burst factor	0.72	0.88	0.96	0.78	0.90	...	...	...	...
Tensile, lb./15 mm.	17.3	19.4	20.0	18.0	20.2	...	...	...	...
Tear factor	1.15	1.03	0.97	1.08	0.97	...	...	...	...
$B \times T$	0.83	0.91	0.93	0.84	0.87	...	...	.	.
$T \times T$	19.9	20.0	19.4	19.4	19.6	...	...	..	..

refiners or of different conditions of operation of a refiner are reflected by the behavior of the product of burst or of tensile and tear.

For the bar refiner, as operated, the development of sheet density, burst, and tensile for the two types of pulps was greater at a given freeness than for the Standard disintegrator. The reduction in tear at corresponding freeness, however, was so much greater that the product of burst or of tensile and tear was slightly below that for the Standard disintegrator.

In the case of the disk refiner, as operated on the one type of pulp, the reduction in tear at the higher degrees of refining was such that the product of burst or of tensile and tear showed a decline with progressive refining which appears to be more pronounced than would be attributable to normal experimental variation.

To the person interested in the thesis of this discussion the monumental investigation reported by Torsten Ekstam, (*1*) of The Research Institute of the Pulp and Paper Industry of Finland is a choice deposit of valuable information. For this report 10 selected pulps were developed in seven different refiners located in four different laboratories. (For description of these pulps and refiners see reference (*1*).)

Pulp handsheets were prepared in all laboratories under standard conditions and all handsheets were tested in The Research Institute of the Pulp and Paper Industry of Finland Central Laboratory. Pertinent data from these studies have been examined from point of view of behavior of the product burst × tear or the product tensile (breaking length) × tear.

Selected representative portions of these results have been assembled for this discussion in Tables V, VI, VI A, and VII.

Table V gives the results from the development of the ten pulps in the Paperindustriens Forsknings Institutt (P.F.I.) mill in Oslo, Norway. Similar results from any one of the other six refiners might have served as well.

Table VI gives a comparison of the seven refiners with one pulp. Any one of seven or eight of the other nine pulps might have served as well. This is shown in the summary data in Table VI A.

Table VII is a condensed compilation of the records for the seven refiners, with each of the ten pulps, at degree of refining corresponding to 50° S-R wetness. (This corresponds to a Canadian Standard freeness of approximately 200 ± 75 ml.) The 50° S-R wetness is the reference point used in several comparisons made by Ekstam.

In compiling Table V the ten pulps have been arranged in the order of decreasing average values for the products of burst and tear. For each pulp the data are given for freeness, sheet density, burst, tear, and breaking length for the range of sheet densities between approximately 0.65 and 0.85. The sheet densities for these pulps as developed by the P.F.I. mill corresponds to Canadian Standard freeness values between approximately 600 and 60 ml.

Because of the method of reporting burst and tear in the Ekstam report, the values for the product burst × tear are of a different order of magnitude than those used in the foregoing tabulations. Each of these values and their products, however, are comparable within the records taken from that report. In Tables V, VI, VI A, and VII the calculated values for the product of burst and tear, as well as the product of breaking length and tear, are divided by 1000.

Except for the bleached aspen sulfite in Table V, there is a relatively constant value for the product burst × tear and for tensile and tear with progressive refining throughout the sheet density range from 0.65 to 0.80. In the case of the short-fiber pulp the value for tear continues to increase with progressive refining. In this respect this pulp resembles the behavior of cotton linter, high alpha- and strongly alkaline extracted wood pulps.

For the "unbleached sulfate long and strong," and the "unbleached sulfite extra strong," one may note a slight decline in the value of burst × tear or of tensile × tear. The decline in these products with progressive refining may have some significance, though it may be attributable to normal experimental variation. In either case, however, the variation would hardly be the cause for confusion from point of rating the pulp in the order of comparative strength.

It is apparent in this table that there would not be good agreement between the strength ratings one would place on the pulps if either burst or tear alone was used as the index. In the right-hand column of this table the values indicate the probable rating one would give these pulps on the basis of (a) burst or tensile, (b) tear, and (c) product of burst and tear or tensile and tear.

It is apparent in this table that if one were to use the product of the two strength attributes as the strength index for nine of these ten pulps, their relative strengths could be established without carrying the refining of the pulps more than one half as far as was used in the study, nor more than one half as far as is generally used in the laboratory determination of pulp strength. The most significant feature of this observation is that it indicates the answers to some of the questions which arise in the evaluation of pulp strength, i.e., (a) "To what extent should one refine a pulp to determine its strength?" or (b) "Is refiner time, refiner power, pulp freeness, or handsheet density the reference point that should be used for pulp strength evaluation?"

The observations made in this representative tabulation of results appear to indicate that the pulp should be developed in the refiner to the point that the values obtained for the two strength attributes are stable from the point of reproducibility. This varies somewhat from pulp to pulp, but for the large majority of pulps used for paper this point is reached by refining the pulp to a freeness of 600 to 500 Canadian Standard. Most of the wet pulps develop the necessary degree of stability at very low degrees of refining. The very dry, high alpha-, alkaline extracted wood pulps and

Table V. Comparative Behavior of Different Pulps—Common Refiner

Papirindustries Forsknings Institute (P.F.I.) Mill—Oslo

							Average $B \times T/1000$ and $L_B \times T/1000$	Strength rating			
								Burst	Tear	$B \times T$	$L_B \times T$
Sulfate, Unbleached, Kraft											
C.S. freeness, ml.	612	292	223	162	97	47	...	..	..	..	..
Sheet density, g./cc.	0.64	0.69	0.72	0.72	0.74	0.76	...	..	..	..	..
Burst F, Mu.	77.3	94.6	96.8	98.8	101.8	103.9	...	1	..	..	..
Tear F	275	237	233	229	227	212	...	..	2	..	..
$B \times T/1000$	....	22.42	22.55	22.63	23.11	22.03	22.55	..	..	1	..
Breaking length (L_B),[a] m.	9290	11,075	11,385	11,665	11,960	12,240	...	..	..	..	..
$L_B \times T/1000$	....	2,625	2,653	2,672	2,715	2,595	2652	..	..	..	1
Sulfate, Unbleached—Long and Strong											
C.S. freeness, ml.	598	342	244	190	128	78	...	..	..	..	..
Sheet density, g./cc.	0.62	0.67	0.69	0.70	0.72	0.73	...	..	..	..	..
Burst F, Mu.	57.3	73.1	75.0	76.1	76.6	79.3	...	3	..	..	..
Tear F	326	279	267	261	250	243	...	..	1	..	..
$B \times T/1000$	....	20.40	20.03	19.86	19.15	19.27	19.76	..	..	2	..
Breaking length, m.	7,717	9,737	10,140	10,365	10,265	10,725	...	..	..	..	..
$L_B \times T/1000$	2,515	2,717	2,707	2,705	2,566	2,534	2624	..	..	..	2
Sulfite, Unbleached—Extra Strong											
C.S. freeness, ml.	535	327	236	155	97	60	...	..	..	..	..
Sheet density, g./cc.	0.64	0.73	0.76	0.78	0.81	0.84	...	..	..	..	..
Burst F, Mu.	47.9	76.7	79.1	80.9	85.7	84.3	...	2	..	..	..
Tear F	196	161	155	149	139	129	...	..	7	..	..
$B \times T/1000$	....	12.35	12.26	12.05	11.91	....	12.14	..	..	3	..
Breaking length, m.	6,930	10,395	10,650	10,900	10,905	10,900	...	..	..	..	..
$L_B \times T/1000$	....	1,674	1,650	1,624	1,516	....	1616	..	..	..	3
Sulfate Unbleached—Easy Bleaching											
C.S freeness, ml.	568	335	248	148	100	60	...	..	..	..	..
Sheet density, g./cc.	0.61	0.67	0.69	0.71	0.74	0.77	...	..	..	..	..
Burst F, Mu.	46.7	57.4	60.3	63.5	64.8	65.5	...	6	..	..	..
Tear F	244	207	198	187	182	175	...	..	3	..	..
$B \times T/1000$	....	11.88	11.94	11.88	11.79	11.46	11.79	..	..	4	..
Breaking length, m.	6,370	7,770	8,050	8,390	8,565	8,745	...	..	..	..	..
$L_B \times T/1000$	....	1,608	1,594	1,569	1,559	1,530	1572	..	..	..	4
Sulfite, Bleached—Extra Strong											
C.S. freeness, ml.	553	320	264	220	117	63	...	..	..	..	..
Sheet density, g./cc.	0.70	0.73	0.76	0.79	0.83	0.86	...	..	..	..	..
Burst F, Mu.	50.1	63.4	67.2	70.2	75.5	77.5	...	4	..	..	..
Tear F	200	178	169	165	154	147	...	..	5	..	..
$B \times T/1000$	....	11.29	11.36	11.58	11.63	11.39	11.45	..	..	5	..
Breaking length, m.	6,895	8,550	8,815	8,995	9,505	9,215	...	..	..	..	..
$L_B \times T/1000$	1,379	1,522	1,490	1,484	1,464	1,355	1449	..	..	..	5
Sulfite, Unbleached—Easy Bleaching											
C.S. freeness, ml.	692	427	297	198	147	81	...	..	..	..	..
Sheet density, g./cc.	0.55	0.73	0.76	0.79	0.80	0.83	...	..	..	..	..
Burst F, Mu.	9.1	49.6?	58.9	62.7	65.0	68.0	...	5	..	..	..
Tear F	142	193	178	167	161	153	...	..	4	..	..
$B \times T/1000$	....	?9.73	10.49	10.50	10.47	10.40	10.47	..	..	6	..
Breaking length, ml.	1,740	6,955	8,090	8,595	8,755	8,910	...	..	..	..	..
$L_B \times T/1000$	....	1,342	1,440	1,435	1,410	1,363	1400	..	..	..	6
Sulfite, Bleached—Strong											
C.S. freeness, ml.	590	420	287	220	120	75	...	..	..	..	..
Sheet density, g./cc.	0.66	0.73	0.76	0.78	0.82	0.84	...	..	..	..	..
Burst F, Mu.	25.5	40.8	47.1	50.3	56.8	58.1	...	7	..	..	..
Tear F	182	155	149	145	140	130	...	..	8	..	..
$B \times T/1000$	....	6.32	7.02	7.29	7.95	7.55	7.23	..	..	7	..
Breaking length, m.	4,080	6,120	6,817	7,165	7,865	7,845	...	..	..	..	..
$L_B \times T/1000$	743	949	1,016	1,039	1,101	1,019	1173	..	..	..	7
Sulfite, Bleached—Rayon											
C.S. freeness, ml.	383	290	237	181	112	....	...	..	..	..	..
Sheet density, g./cc.	0.67	0.70	0.71	0.73	0.76	....	...	..	..	..	..
Burst F, Mu.	32.6	36.3	38.3	39.4	42.3	....	...	9	..	..	..
Tear F	169	163	159	153	144	....	...	..	6	..	..
$B \times T/1000$	....	6.02	6.09	6.03	6.09	....	6.06	..	..	8	..
Breaking length, m.	4,890	5,235	5,390	5,550	5,770	....	...	..	..	..	..
$L_B \times T/1000$	826	853	857	849	831	....	843	..	..	..	8
Sulfite, Bleached Soft											
C.S. freeness, ml.	530	290	262	150	105	65	...	..	..	..	..
Sheet density, g./cc.	0.65	0.71	0.72	0.75	0.78	0.81	...	..	..	..	..
Burst F, Mu.	29.4	40.9	41.6	45.7	47.2	48.5	...	8	..	..	..
Tear F	147	123	122	117	109	103	...	..	9	..	..
$B \times T/1000$	....	5.03	5.08	5.35	5.15	5.00	5.12	..	..	9	..
Breaking length, m.	4,310	5,865	6,000	6,435	6,850	7,000	...	..	..	..	..
$L_B \times T/1000$	634	721	732	753	747	721	718	..	..	..	9
Sulfite, Bleached Aspen											
C.S. freeness, ml.	428	297	236	230	218	278?	...	..	..	..	..
Sheet density, g./cc.	0.68	0.73	0.77	0.78	0.80	0.84	...	..	..	..	..
Burst F, Mu.	15.1	24.2	29.9	30.5	32.2	36.9	...	10	..	..	..
Tear F	75	94	97	98	103	112	...	..	10	..	..
$B \times T/1000$	....	2.28	2.91	2.99	3.32	4.13	3.13	..	..	10	..
Breaking length, m.	3,145	4,300	4,905	4,955	4,925	5,450	...	..	..	..	..
$L_B \times T/1000$	....	384	475	490	505	610	491	..	..	..	10

[a] L_B = breaking length.

Table VI. Comparative Performance of Refiners with Common Pulp

Sulfite, Unbleached—Extra Strong

								Average $B \times T/1000$ — $L_B \times T/1000$	Refiner ratings — Burst	Tear	$B \times T$	$L_B \times T$
Lampen Mill—Helsingfors, Finland												
C.S. freeness, ml.	701	523	326	218	180	88	28					
Sheet density, g./cc.	0.59	0.75	0.79	0.81	0.81	0.83	0.86					
Burst F, Mu.	28.2	80.7	88.6	91.9	93.2	94.5	91.7		1			
Tear F	218	168	148	141	198?	148	129			4		
$B \times T/1000$		13.36	13.11	12.96		13.33		13.19			1	
Breaking length, m.	5,025	11,035	12,055	12,300	12,415	12,415	12,015					
$L_B \times T/1000$		1,854	1,784	1,734		1,734	1,550	1777				1
Lampen Mill—Oslo, Norway												
C.S. freeness, ml.	393	293	249	173	112							
Sheet density, g./cc.	0.76	0.78	0.80	0.83	0.85							
Burst F, Mu.	83.0	87.0	89.1	92.6	93.9				2			
Tear F	158	151	145	106?	127					7		
$B \times T/1000$	13.11	13.14	12.92		12.03			12.80			2	
Breaking length, m.	11,305	11,815	12,000	12,360	12,335							
$L_B \times T/1000$	1,786	1,784	1,740		1,567			1719				3
Banning and Seybold (Bus) Beater—Skonsmon, Sweden												
C.S. freeness, ml.	649	547	404	241	218	72						
Sheet density, g./cc.	0.65	0.68	0.71	0.73	0.74	0.75						
Burst F, Mu.	49.9	60.0	68.9	73.9	74.9	76.1			6			
Tear F	206	197	190	189	188	173				1		
$B \times T/1000$	10.28	11.82	13.09	13.97	14.08	13.17		12.73			3	
Breaking length, m.	6,875	8,375	9,125	9,600	9,685	9,655						
$L_B \times T/1000$	1,416	1,650	1,734	1,814	1,821	1,670		1684				5
Valley Beater—Helsingfors, Finland												
C.S. freeness, ml.	682	446	300	229	171	55						
Sheet density, g./cc.	0.61	0.71	0.73	0.75	0.76	0.80						
Burst F, Mu.	34.7	69.6	73.1	74.2	75.1	73.9			5			
Tear F	217	180	166	163	160	149				3		
$B \times T/1000$		12.53	12.14	12.17	12.02			12.21			4	
Breaking length, m.	5,790	10,140	10,490	10,565	10,640	10,495						
$L_B \times T/1000$		1,825	1,741	1,722	1,702			1747				2
Papirindustriens Forsknings Institutt Mill (P.F.I.)—Olso, Norway												
C.S. freeness, ml.	535	327	236	155	97	60						
Sheet density, g./cc.	0.64	0.7	0.76	0.78	0.81	0.84						
Burst F, Mu.	47.9	76.7	79.1	80.9	85.7	84.3			3			
Tear F	196	161	155	149	139	129				6		
$B \times T/1000$		12.35	12.26	12.05	11.91			12.19			5	
Breaking length, m.	6,930	10,395	10,650	10,900	10,905	10,900						
$L_B \times T/1000$		1,673	1,651	1,624	1,516			1616				6
Noble & Wood (N&W) Beater—Helsingfors, Finland												
C.S. freeness, ml.	681	532	387	271	227	174	32					
Sheet density, g./cc.	0.62	0.69	0.71	0.73	0.74	0.76	0.80					
Burst F, Mu.	37.9	63.6	71.7	74.7	75.5	75.6	70.1		4			
Tear F	220	183	174	165	162	159	135			2		
$B \times T/1000$		11.64	12.48	12.33	12.23	12.02		12.14			6	
Breaking length, m.	6,010	9,135	10,105	10,495	10,525	10,580						
$L_B \times T/1000$		1,672	9,758	1,722	1,705	1,682		1708				4
Aylesford Beater—A. E. Reed Laboratory, England												
C.S. freeness, ml.	648	537	380	299	234	219	180					
Sheet density (g./cc.)	0.64	0.69	0.74	0.76	0.77	0.78	0.80		7			
Burst F, Mu.	42.1	56.5	66.0	68.2	70.3	70.8	72.0		7			
Tear F	203	186	167	154	144	142	136			5		
$B \times T/1000$		10.51	11.02	10.50	10.12	10.05	9.79	10.44			7	
Breaking length, m.	6,425	8,225	9,335	9,670	9,895	9,950	10,055					
$L_B \times T/1000$		1,530	1,559	1,489	1,427	1,413	1,367	1484				7

cotton linters require refining to an appreciably greater degree.

Table VI has been compiled to examine the behavior of each of the seven refiners with one of the ten pulps. As in the foregoing records, the product of burst and tear for range of sheet density between 0.65 and 0.85 is used to indicate strength of the pulp. Since this tabulation is for a common pulp, developed by different refiners, the strength index may be considered as an index to the performance characteristics of the refiners. Using this product as an index to refiner performance, the records have been arranged in the order of the ability of the refiner to develop high values of this product.

The numbers in the right-hand column of Table VI indicate the rating of the seven refiners with this pulp when (a) burst, (b) tear, or (c) the product of burst and tear are used as indexes to refiner performance. With the product of burst and tear as the index, the differences between six of the seven refiners is rather small. These differences may be of the order of normal experimental variation. Only the Aylesford beater gives a distinctly different value for this product of the two strength attributes for this pulp.

In this tabulation there is the suggestion that for some refiners there is a tendency for the product of the two attributes to increase with progressive refining. For others there is a tendency for the product of the two attributes to decrease with progressive refining. These tendencies are not pronounced and may be attributable to normal experimental variation. They may, however, be reproducible and may have some significance.

The behavior of the product of burst and tear for the seven refiners, over the sheet density range from 0.60 to 0.85, is illustrated in Table VI A. In this tabulation it may be noted that, for the Valley beater and the Noble and Wood beater at Helsingfors, the product of the two strength attributes tends to decrease for all pulps with progressive refining. The Helsingfors Lampen mill displays this tendency in the case of two of the pulps. This characteristic is not evident for the other refiners, though for one pulp refined by the Banning and Seybold (B & S) beater in Skonsmon, Sweden, and for two pulps refined by the P.F.I. mill at Oslo there is the tendency of the product to increase with progressive refining.

In Table VII the pulps have been arranged in the order of decreasing averages of values for the product of burst and tear for the seven refiners (see right-hand column of the tabulation). The refiners have been arranged from left to right in the order of decreasing average of values for the

Table VI A. Product of $B \times T$ for Seven Refiners with Nine Pulps

Comparison at Common Sheet Density

	Handsheet density, g./cc.										
	0.600–0.649	0.650–0.674	0.675–0.699	0.700–0.724	0.725–0.749	0.750–0.774	0.775–0.799	0.800–0.824	0.825–0.849		
Aylesford Beater—England											
Sulfite, bleached											
Extra strong	...	7.93	...	8.26	8.45	8.02	...	7.76	...	...	...
Strong	4.29	...	4.84	4.85	4.69	4.50	4.05	...	...	...	
Soft	3.16	...	3.34	3.27	3.21	3.97	2.90	...	...	...	...
Rayon	...	3.20	3.16	3.19	...	...	...	...	...	...	...
Sulfite unbleached											
Extra strong	8.55	...	10.51	...	11.02	10.50	10.12	9.64	8.86	...	...
Easy bleaching	5.83	6.69	6.88	...	6.89	6.76	6.53	6.38	...	...	...
Sulfate unbleached											
Kraft	16.07	16.60	16.38	16.07	14.75	14.36	..	...	...	...	...
L & S	14.87	15.73	14.93	14.13	13.44	...	...	...	...		...
Easy bleaching	8.89	8.61	...	8.40	7.44	...	...	...	...	...	...
B & S—Skonsmon											
Sulfite, bleached											
Extra strong	9.85	...	11.25	11.19	11.11	..	...	...	...	...	...
Strong	5.85	6.95	7.11	...	...	...	...	...	...	...	...
Soft	4.16	4.23	4.34	...	...	...	...	...	...	...	..
Rayon	...	5.90	...	...	...	...	...	...	...	...	..
Sulfite unbleached											
Extra strong	10.28	...	11.82	13.09	14.08	13.17	...	...	...	...	.
Easy bleaching	7.86	8.97	...	10.46	10.40	...	...	...	...		
Sulfate unbleached											
Kraft	18.20	17.66	...	...	...	...	...	..	...	...	...
L & S	16.77	16.98	...	14.16	...	..	...	...	...	...	...
Easy bleaching	11.68	11.30	...	...	...	...	...	...	...	...	..
P.F.I. Mill—Oslo											
Sulfite, bleached											
Extra strong	..	...	. .	10.02	11.29	...	11.58	...	11.63	...	...
Strong	..	4.64	...	6.32	...	7.29	...	7.95	7.55	...	...
Soft	...	4.32	...	5.03	5.35	...	5.15	5.00	...	...	...
Rayon	...	5.51	...	6.09	6.03	6.09	...	...	...	...	..
Sulfite unbleached											
Extra strong	9.39	...	...	...	12.35	...	12.05	11.91	10.88	...	. .
Easy bleaching	...	...	...	...	9.58	10.49	10.47	...	10.40	...	...
Sulfate unbleached											
Kraft	21.26	...	22.42	22.63	23.11	22.03	..	...	...	...	...
L & S	18.08	20.40	19.86	19.15	19.27	...	...	...	...	...	..
Easy bleaching	11.40	11.88	...	11.88	11.79	11.46	...	...	...	...	...
Lampen Mill—Olso											
Sulfite, bleached											
Extra strong	...	.	.	..	...	...	...	10.62	10.49	10.98	...
Strong	..	...	...	.	...	5.65	...	6.22	6.64	5.55	...
Soft	...	...	...	...	...	3.41	3.41	3.27	...	...	..
Rayon	.	...	2.31	...	2.66	2.66	2.68	...	...	...	...
Sulfite unbleached											
Extra strong	...	...	...	...	...	13.11	13.14	29.82	12.03	...	
Easy bleaching	...	..	...	...	...	...	8.72	8.84	...	9.25	...
Sulfate unbleached											
Kraft	...	...	19.91	20.76	19.66	20.34	...	...	...	...	...
L & S	...	..	...	15.28	15.10	14.81	13.66	...	...	...	...
Easy bleaching	...	...	7.72	7.75	7.68	7.13	...	...	...	...	...
Valley Beater—Helsingfors											
Sulfite, bleached											
Extra strong	...	...	...	...	...	...	11.72	10.67	...	9.25	
Strong	...	5.99	...	7.16	7.37	6.96	...	6.16	...	...	...
Soft	4.81	...	...	5.11	5.01	...	4.80	...	...	...	...
Rayon	...	5.19	...	5.82	...	5.35	4.70	...	...	...	...
Sulfite unbleached											
Extra strong	...	...	...	12.53	12.14	12.02	11.01	...	9.08	...	...
Easy bleaching	...	...	8.61	...	9.79	9.80	...	8.57	7.12	...	...
Sulfate unbleached											
Kraft	23.54	...	25.10	24.04	...	20.52	...	...	...	...	..
L & S	24.49	23.73	22.18	...	...	17.90	...	...	...	...	...
Easy bleaching	12.12	...	11.91	10.73	...	...	...	8.38	...	...	...
Lampen Mill—Helsingfors											
Sulfite, bleached											
Extra strong	...	...	...	...	...	...	11.36	...	11.88	11.65	11.12
Strong	...	...	...	...	683	...	...	...	7.09	...	6.99
Soft	...	...	...	...		...	...	3.34	5.56	...	3.40
Rayon	...	...	...	2.65	...	...	...	2.63	2.60	...	3.11
Sulfite unbleached											
Extra strong	...	..	...	...	...	13.36	13.11	...	13.33	11.83	
Easy bleaching	...	...	...	...	...	9.09	...	9.30	...	9.25	9.10
Sulfate unbleached											
Kraft	20.90	...	21.07	...	19.37	...	18.72	...	...	...	...
L & S	18.33	...	17.59	...	15.80	...	15.27	...	...	...	...
Each bleaching	...	...	...	...	...	...	6.24	6.36	6.17	...	...
N. & W. Beater—Helsingfors											
Sulfite, bleached											
Extra strong	...	...	10.18	10.79	...	10.23	...	9.21	8.75	...	
Strong	...	5.90	...	6.88	6.74	6.53	5.71	...	...	...	
Soft	...	...	4.25	4.27	...	4.03	3.68	...	...	...	..
Rayon	...	5.63	5.33	5.03	...	4.46	...	...	...	...	...
Sulfite unbleached								...	..	...	...
Extra strong	...	...	11.64	12.48	12.33	12.02	...	9.48			
Easy bleaching	...	...	9.10	9.85	10.14	10.27	9.06	...	...	...	...
Sulfate unbleached								...	...	...	...
Kraft	18.69	19.47	18.91	...	16.66	...	...	...	...	...	...
L & S	...	18.89	18.58	18.03	15.57	...	...	...	...	...	...
Easy bleaching	11.80	...	11.26	...	10.24	9.29	...	...	...	...	...

product of burst and tear for the ten pulps (note values at bottom of the tabulation).

While there is some irregularity in agreement between individual ratings of the refiners for individual pulps, it is more important to note that the frequency of disagreement is so low. Of the 14 cases of disagreement almost all involve very small differences in pulp strengths and 11 of the cases involve values for the two Lampen mills. For either burst or tear alone as an index of pulp strength the agreement between the several refiners is not nearly as good.

If the seven refiners used in this study were mill production units, and the product burst × tear were to be used as the index for refiner characterization, one would rate the Helsingfors Valley beater as the one which would give best strength development in a pulp. The P.F.I. mill at Oslo, the Noble and Wood beater at Helsingfors, and the B. and S beater at Skonsmon would rate as close second choices. The Lampen mill at Oslo or the Aylesford beater at Reed would not be expected to develop pulp strength to the degree one would get with the first four refiners. This difference in refiner performance is appreciable and as such would be an item of concern in the selection of a mill refiner.

In the endeavor to improve the degree of reproducibility of results and the agreement between different beaters in the

Table VII. Condensed Comparison, Seven Refiners—Ten Pulps

Comparison of $B \times T/1000$ at 50° S-R

	Valley beater—Helsingfors	*P.F.I. mill—Oslo*	*N & W beater—Helsingfors*	*B & S beater—Skonsmon*	*Lampen mill—Helsingfors*	*Lampen mill—Olso*	*Aylesford beater—Reed*	*Average for seven refiners*
Sulfate, Unbleached Kraft								
Refining time, min.	101	5.2	47	46	132	153	51	....
Sheet density, g./cc.	0.69	0.72	0.67	0.64	0.74	0.73	0.72	0.70
Burst F, Mu.	(1) 96.8	(1) 96.8	(1) 78.7	(2) 68.7	(2) 90.1	(1) 93.9	(1) 70.9	(1) 85.1
Tear F	(2) 257	(2) 233	(2) 246	(2) 263	(2) 215	(1) 212	(2) 221	(2) 235
$B \times T/1000$	(1) 24.89	(1) 22.55	(1) 19.36	(1) 18.07	(1) 19.37	(1) 19.91	(1) 15.67	(1) 19.98
Sulfate, Unbleached—Long & Strong								
Refining time, min.	75	5.5	42	37	104	120	43	....
Sheet density, g./cc.	0.68	0.69	0.68	0.65	0.73	0.74	0.69	0.69
Burst F, Mu.	(2) 80.8	(3) 75.0	(3) 71.1	(3) 59.8	(4) 74.2	(4) 70.5	(3) 56.2	(3) 69.6
Tear F	(1) 284	(1) 267	(1) 262	(1) 283	(1) 221	(2) 210	(1) 261	(1) 255
$B \times T/1000$	(2) 22.95	(2) 20.03	(2) 18.63	(2) 16.92	(2) 16.40	(2) 14.81	(2) 14.67	(2) 17.77
Sulfite, Unbleached—Extra Strong								
Refining time, min.	36	1.4	34	19	56	82	25	....
Sheet density, g./cc.	0.75	0.76	0.74	0.73	0.81	0.80	0.78	0.78
Burst F, Mu.	(3) 74.2	(2) 79.1	(2) 75.5	(1) 73.9	(1) 91.9	(2) 89.1	(2) 70.8	(1) 79.2
Tear F	(6) 163	(7) 155	(6) 162	(7) 189	(6) 141	(5) 145	(7) 142	(4) 171
$B \times T/1000$	(3) 12.17	(3) 12.26	(3) 12.23	(3) 13.97	(3) 12.96	(3) 12.92	(3) 10.05	(3) 12.37
Sulfate, Unbleached—Easy Bleaching								
Refining time, min.	....	....	....	....	....	....	....	....
Sheet density, g./cc.	0.68	0.69	0.68	0.64	0.76	0.74	0.67	0.69
Burst F, Mu.	(6) 57.6	(6) 60.3	(5) 54.8	(6) 48.3	(7) ?42.9	(7) 47.5	(6) 42.1	(6) 50.5
Tear F	(3) 207	(3) 198	(3) 208	(3) 236	(3) 155	(3) 163	(3) 203	(3) 196
$B \times T/1000$	(4) 11.92	(4) 11.94	(4) 11.40	(4) 11.40	(7) ?6.65	(6) 7.74	(4) 8.55	(4) 9.94
Sulfite, Bleached—Extra Strong								
Refining time, min.	59	1.5	29	21	61	79	29	....
Sheet density, g./cc.	0.77	0.76	0.75	0.71	0.88	0.84	0.75	0.78
Burst F, Mu.	(4) 65.9	(4) 67.2	(4) 59.3	(4) 56.9	(3) 78.7	(3) 73.0	(4) 51.2	(4) 64.6
Tear F	(4) 177	(5) 169	(5) 174	(5) 196	(4) 148	(6) 144	(4–5) 160	(6) 167
$B \times T/1000$	(5) 11.66	(5) 11.36	(5) 10.32	(5) 11.15	(4) 11.65	(4) 10.51	(5) 8.19	(5) 10 69
Sulfite, Unbleached—Easy Bleaching								
Refining time, min.	54	2.0	44	26	61	126	38	....
Sheet density, g./cc.	0.76	0.79	0.74	0.72	0.86	0.84	0.75	0.78
Burst F, Mu.	(5) 58.7	(5) 62.9	(6) 54.3	(5) 50.3	(5) 62.9	(5) 59.6	(5) 42.5	(5) 55.9
Tear F	(5) 167	(4) 167	(4) 187	(4) 207	(5) 147	(4) 152	(4–5) 160	(5) 169
$B \times T/1000$	(6) 9.80	(6) 10.50	(6) 10.15	(6) 10.41	(5) 9.25	(5) 9.06	(6) 6.80	(6) 9.43
Sulfite, Bleached—Strong								
Refining time, min.	55	1.2	27	16	66	61	29	....
Sheet density, g./cc.	0.74	0.76	0.72	0.68	0.87	0.83	0.72	0.76
Burst F, Mu.	(7) 47.8	(7) 47.1	(7) 42.8	(7) 39.3	(6) 54.8	(6) 47.8	(7) 33.3	(7) 44.7
Tear F	(8) 152	(8) 149	(7–8) 157	(8) 180	(7) 129	(7) 133	(6) 143	(7) 149
$B \times T/1000$	(7) 7.27	(7) 7.02	(6) 6.77	(7) 7.07	(6) 7.07	(7) 6.36	(7) 4.76	(7) 6.62
Sulfite, Bleached—Rayon								
Refining time, min.	56	2.0	25	15	102	110	32	....
Sheet density, g./cc.	0.70	0.70	0.68	0.64	0.83	0.77	0.68	0.71
Burst F, Mu.	(9) 37.1	(8) 36.3	(9) 34.3	(8) 30.1	(10) 26.6	(9) 23.8	(8) 23.6	(9) 30.2
Tear F	(7) 153	(6) 163	(7–8) 158	(6) 190	(8) 96	(8) 112	(8) 134	(8) 144
$B \times T/1000$	(8) 5.68	(8) 6.02	(8) 5.42	(8) 5.72	(10) 2.55	(9) 2.67	(9) 3.16	(8) 4.46
Sulfite, Bleached—Soft								
Refining time, min.	38	1.35	19	12	69	130	30	....
Sheet density, g./cc.	0.73	0.72	0.71	0.67	0.87	0.80	0.72	0.74
Burst F, Mu.	(8) 42.0	(9) 41.6	(8) 35.0	(9) 32.1	(7) 40.2	(8) 35.2	(9) 29.0	(8) 36.4
Tear F	(9) 121	(9) 122	(9) 123	(9) 133	(9) 87	(9) 95	(9) 111	(9) 113
$B \times T/1000$	(9) 5.08	(9) 5.08	(9) 4.31	(9) 4.30	(9) 3.50	(8) 3.34	(8) 3.22	(9) 4.12
Sulfite, Bleached—Aspen								
Refining time, min.	74	1.45	51	10	137	....	50	....
Sheet Density, g./cc.	0.77	0.77	0.74	0.69	0.86	0.74	0 78	0.76
Burst F, Mu.	(10) 32.9	(10) 29 9	(10) 27.5	(10) 20.7	(9) 37.8	(10) 22.6	(10) 23.1	(10) 27.8
Tear F	(10) 100	(10) 97	(10) 100	(10) 95	(10) 94	(10) 88	(10) 80	(10) 93
$B \times T/1000$	(10) 3.29	(10) 2.91	(10) 2.75	(10) 1.97	(8) 3.55	(10) 1.99	(10) 1.85	(10) 2.62
Average for All Pulps								
Refining time, min.	61	2.4	35	22	88	108	36	....
Sheet density, g./cc.	0.73	0.74	0.71	0.68	0.82	0.78	0.73	....
Burst F, Mu.	(3) 59.4	(2) 59.6	(7) 33.3	(5) 48.0	(1) 60.0	(4) 56.3	(6) 44.3	....
Tear F	(2–3) 178	(4)172	(2–3) 178	(1) 197	(7) 143	(6) 145	(5) 161	....
$B \times T/1000$	(1) 11.47	(2) 10.97	(3) 10.13	(4) 10.10	(5) 9.29	(6) 8.93	(7) 7.69	....

The numbers in parentheses adjoining each individual record indicates the rating of the pulp strength on the basis of the attribute developed by the individual refiner. The numbers in parentheses adjoining the average of values for the pulps in the right-hand column of the table indicate the strength rating of the pulp by average of that attribute for the seven refiners. The numbers in parentheses at the bottom of the table indicate the rating of the refiner as indicated by the average of values for the attribute as developed in the ten pulps.

evaluation of pulp strength, the Pulp Testing Committee of TAPPI selected a pulp to be used as a reference pulp for checking the performance of the laboratory beater. The results from 43 beater tests made on this pulp in ten different laboratories were reported in *Tappi* during 1957 and 1958 by Brandon (*2, 3, 4*) and by Winchester (*5*).

In the cases where two or more determinations were reported by one laboratory, those data were examined from the point of this discussion. The results for 20-, 35-, and 50-min. refining periods are summarized in Table VIII. The results for the 5-min. refining period are not included for the reason that results for small degrees of refining are not useful to the thesis of this discussion.

It may be significant that the data from the Valley beater measurements appear to fall into two (or possibly three) groups: (a) those for which the product burst × tear decreases with progressive refining, (b) those for which this product increases with progressive refining, and (c) possibly those for which this product does not appear to follow either trend. These results are all for the refining of several specimens from one lot of pulp. The differences would appear to be due primarily to differences in condition of equipment and/or to differences in operator technique.

Table VIII. TAPPI Reference Pulp Developed in Valley Beater

Test no.	*C.S. freeness, ml.*	*Sheet density, g./cc*	*Burst factor*	*Tear factor*	*B × T*
		20-Minute Beating			
1 (2)	460	0.67	37.1	91.5	3400
2 (4)	402	..	38.0	90.0	3410
6 (2)	480	0.69	42.3	86.1	3647
8 (8)	281	0.74	41.2	80	3307
9 (2)	408	0.70	38.0	96	3640
10 (7)	486	0.71	37.5	86	3224
Average	420	0.70	40.7	88	3438
4 (4)	500	0.70	34.6	89	3057
4 (4)	501	0.71	36.0	88	3135
5 (4)	545	0.63	28.7	106	3052
23 (2)	545	0.64	31.5	104	3262
29 (2)	435	..	36.4	93	3370
Average	505	0.67	33.4	96	3160
3 (4)	451	0.69	41.0	82	3362
11 (4)	557	0.75	33.1	116	3824
		35-Minute Beating			
1 (2)	222	0.74	44.5	68.2	3033
2 (4)	150	..	45.1	74.1	3347
6 (2)	198	0.75	50.4	68.2	3451
8 (8)	62	0.81	46.5	67.0	3060
9 (2)	163	0.78	43.9	78.8	3468
10 (7)	230	0.77	44.6	69.0	3078
Average	171	0.77	45.8	70.9	3240
4 (4)	260	0.75	44.7	75	3370
4 (4)	230	0.76	44.7	74	3330
5 (4)	361	0.67	37.9	86	3275
23 (2)	330	0.66	44.0	83	3650
29 (2)	160	..	43.5	72	3155
Average	268	0.71	43.0	78	3356
3 (4)	201	0.75	49.8	68	3361
11 (4)	334	0.84	47.9	85	4040
		50-Minute Beating			
1 (2)	82	0.79	49.4	61.3	3030
2 (4)	43	..	45.0	60.2	2709
6 (2)	80	0.80	50.7	58.7	2977
8 (8)	9	0.83	44.0	57.5	2530
9 (2)	61	0.80	46.5	64.2	2968
10 (7)	84	0.79	47.7	62	2971
Average	60	0.80	47.2	61	2864
4 (4)	104	0.79	49.2	72	3525
4 (4)	89	0.79	48.4	68	3283
5 (4)	215	0.70	46.8	80	3567
23 (2)	140	0.69	49.9	73	3640
29 (2)	55	..	49.6	73	3560
Average	121	0.74	48.8	73	3515
3 (4)	63	0.80	54.1	56	3047
11 (4)	149	?	51.5	68	3536

This difference in behavior of the two groups of data in this case prompts one to search for possible cause. The departure from constancy of the product of burst and tear is large enough to appear to have significance, though the cause for the difference in behavior of the different beaters is not obvious.

The variations in values for the product of burst and tear between the several beaters within each group is rather pronounced. These differences in the product of the two values, however, are not as large as are the differences between the values for the separate attributes. Though this does not account for the differences in behavior of the product of burst and tear in the different groups, it may be significant to note in each group that when the value for burst is below the average for the group the corresponding value for tear is usually above the average for that attribute for the group.

From point of difference between the two extreme groups, for the group in which the product decreases with progressive refining the time required to develop a given sheet density or to develop maximum burst was appreciably less than for the group in which the product of the two attributes increased with progressive refining. This suggests that in the first group the beaters had more tendency to "cut" than those for which the product of burst and tear increased with progressive refining.

In the light of this and other observations of the tendency of the product burst × tear to deviate from constancy with progressive refining, a short study was made of the effect upon the product of these two attributes of variation in

Table IX. Influence of Beater Bed Plate Loading upon Refiner Characteristics as Indicated by Product of *B × T*

	Western kraft, dry bleached	*Scandinavian, sulfite, unbleached*	*Mitscherlich, wet, unbleached*	*Hardwood sulfate, wet, bleached*
		11,000-Gram Loading—2.0 × TAPPI Std.		
Minutes, 600 to 300 C.S.	10.5	6.5	6.5	
B × T at 600 C.S.	9.8	6.5	5.6	
B × T at 300 C.S.	8.0	6.0	3.9	
Decrease in *B × T*, 600 to 300	1.8	0.5	1.7	
Minutes, 400 to 200 C.S.				7.5
B × T at 400 C.S.				3.8
B × T at 200 C.S.				3.2
Decrease in *B × T*, 400 to 200				0.6
		5500-Gram Loading—1.0 × TAPPI Std.		
Minutes, 600 to 300 C.S.	16.0	10.5	10.5	
B × T at 600 C.S.	11.9	6.7	6.0	
B × T at 300 C.S.	10.2	6.3	4.9	
Decrease in *B × T*, 600 to 200	1.7	0.4	1.1	
Minutes, 400 to 200 C.S.				14.5
B × T at 400 C.S.				4.5
B × T at 200 C.S.				4.0
Decrease in *B × T*, 400 to 200				0.5
		2750-Gram Loading—0.5 × TAPPI Std.		
Minutes, 600 to 300 C.S.	28.5	18.0	16.0	
B × T at 600 C.S.	12.5	7.1	6.1	
B × T at 300 C.S.	11.6	6.9	5.1	
Decrease in *B × T*, 600 to 300	0.9	0.2	1.0	
Minutes, 400 to 200 C.S.				25.5
B × T 400 C.S.				4.7
B × T 200 C.S.				4.2
Decrease in *B × T*, 400 to 200				0.2

pressure, or clearance, between the bed plate and the rotor of the Valley beater. The results for three different loadings with four different types of pulps are summarized in Table IX.

The condition of the beater, or of its operation, was such that there was a tendency for the product burst × tear to decrease with progressive refining, at any loading. The difference in degree of decrease for the different loadings, however, was used as a measure of the change in behavior of this index with change in pressure between the bed plate and beater rotor. For the three long-fiber pulps 600 and 300 Canadian Standard freeness were used as the reference points. For the short-fiber pulp 400 and 200 were used.

As was to be expected, the time of refining required to reduce the freeness of the pulp from the higher to the lower point was less for the higher than for the lower bed-plate loading. It may be significant that the resultant handsheet density, at a given freeness, increased with each increase in loading. In each case the product burst × tear for each of the pulps decreased with each increase in loading. At the higher degrees of refining (300 and 200 Canadian Standard) the product burst × tear is 20 to 25% lower for 11,000 than for 2750-g. loading.

The third observation in this series of measurements is that with each increase in loading from 2750 to 5500 g. and to 11,000 there is a more pronounced decrease in the product burst × tear with refining the pulps from the higher to the lower freeness reference point. This decrease in the product of the two attributes is approximately twice as large for the 11,000- than for the 2750-g. loading.

There are enough exceptions to the rule to make it hazardous to generalize from the records reviewed in this discussion, but there is too much evidence to ignore which indicates that (a) the higher-than-average sheet density for a given pulp freeness, (b) lower-than-normal product burst × tear for a particular pulp, and (c) decrease in the value of the product burst × tear with progressive refining are associated with a common cause. This common cause appears to be high degree of fiber "cutting."

SUMMARY AND CONCLUSIONS

There is obviously much more work to be done before one should be positive in generalizations relative to the selection, design, arrangement, or conditions of operation of production refiners. At this point one can only suggest that the thesis of this discussion may have value as a tool in the characterization of refiner behavior.

It does appear, however, that the use of the product of burst × tear, or of tensile × tear, does point to answers to many of the questions related to the evaluation of pulp strength. It also appears to do much to separate out from pulp strength evaluation the impact of the refiner characteristics.

It appears that if this product is used as an index, one needs, for the large majority of pulps, refine to but one degree which will give a freeness value between 550 and 300 Canadian Standard, or which will give a sheet density between 0.70 and 0.80 g. per cc. For most pulps this is equivalent to between $^1/_3$ and $^2/_3$ the degree of refining required to develop maximum burst.

The use of the product of $B \times T$ takes the two attributes of pulp strength into account in one index. This use of the index removes the complications involved in the comparison of two pulps which have divergent tendencies to develop burst or tensile versus retain resistance to tear in response to refiner action.

The use of this index appears to minimize the complexity of the problem of correlation between the results of laboratory evaluation and performance of the pulp in the mill refiner. It appears to indicate that a "strong pulp" is a "strong pulp" for any refiner, though some refiners develop these strength potentials to a high degree than do others. It appears to become more important to characterize the performance of the production refiner than to be ever raising the question as to how does one correlate the pulp strength evaluations and the performance of the pulp in the mill.

Though the differences between refiners may be minimized through the use of the product burst × tear as an index, the observed difference in performance of refiners indicated that one important source of variation in pulp evaluation could be removed if the refiner used for the purpose were free of close clearance elements where pressure application or condition of shearing surfaces may be critical or difficult to reproduce. It appears that with the use of the product burst × tear, or of tensile × tear, as an index, pulp strength evaluation can be most reliably done with a refiner which does not depend upon the characteristics of close clearance surfaces for pulp strength development.

LITERATURE CITED

1. Ekstam, Torsten, *Tappi* Vol. 38, No. 9: 24A–72A (Sept., 1955).
2. Brandon, O. E., *Tappi* Vol. 40, No. 12: 178A–180A (Dec., 1957).
3. Brandon, O. E., *Tappi* Vol. 41, No. 7: 120A–124A (July, 1958).
4. Brandon, O. E., *Tappi* Vol. 41, No. 9: 129A–132A (Sept., 1958).
5. Winchester, A. J., *Tappi* Vol. 41, No. 12: 173A–178A (Dec., 1958).

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For a complete treatment of the tabulated results, the reader should refer to the original paper cited in reference (1).

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UNITED STATES PATENTS ON PAPERMAKING

First Quarter, 1960 — *Compiled by The Institute of Paper Chemistry*

THE following list of United States patents has been compiled from the current numbers of the Official Gazette of the United States Patent Office. Because, as a rule, only one claim is published in the gazette, it is not claimed that the list is complete; also, it is possible that the list may contain some patents that do not apply specifically to pulp and paper manufacture. Copies of any of the following patents may be obtained from the United States Patent Office, Washington 25, D. C., by sending twenty-five cents for each patent desired. Or, those desiring the patents on *microcards* should write to The Institute of Paper Chemistry, Appleton, Wisconsin.

Jan. 5, 1960

Allen, William H. Container for foods. U. S. pat. 2,919,846. Filed July 7, 1958. 6 claims. Assigned to Allen Cartons, Inc. [Cl. 229-87.] Shingled strips of bacon are packed on a paperboard backing member and overwrapped in film.

Anderson, Ralph F. Multi-stack cup magazine. U. S. pat. 2,919,830. Filed June 20, 1956. 6 claims. [Cl. 221-11.] A machine for dispensing paper cups is provided with a magazine which holds a number of vertical stacks of nested cups.

Anderson, Wilbur G., Jr. Carton for cups. U. S. pat. 2,919,844. Filed Jan. 10, 1958. 1 claim. Assigned to American Box Board Co. [Cl. 229-28.] A unitizing container is provided for a number of paper cups filled with frozen food.

Arneson, Edwin L. Can packaging machine. U. S. pat. 2,919,526. Filed Sept. 13, 1957. 4 claims. Assigned to Federal Paper Board Co. [Cl. 53-59.] A paperboard blank is wrapped about an assembled group of cans to form a unitized pack in an open-end sleeve-type carton.

Batlas, George X. Paper toweling and dispenser therefor. U. S. pat. 2,919,842. Filed March 11, 1957. 14 claims. [Cl. 225-12.] A wall-mounted dispenser for rolls of paper toweling is designed to hold a supply roll and a reserve roll.

Briggs, Southwick W. Filter. U. S. pat. 2,919,807. Filed Dec. 3, 1957. 11 claims. [Cl. 210-487.] A filter element is formed from resin-impregnated pleated paper.

Brookhyser, Byron B., Erickson, Harold E., and Schubert, Dale L. Mat transfer apparatus. U. S. pat. 2,919, 820. Filed Feb. 21, 1956. 16 claims. Assigned 1/6 to Schubert and 50% to Industrial Devt. Co. [Cl. 215-1.] A mat of wood particles is moved onto a caul plate without damaging the mat.

Brownlee, Kenneth H. Carton slitting device. U. S. pat. 2,919,488. Filed March 10, 1958. 11 claims. Assigned to The Meyercord Co. [Cl. 30-2.] A cigarette carton is slit open so that tax stamps or the like may be applied to the cigarette packs within.

Coakley, Lige. Bag machinery. U. S. pat. 2,919,789. Filed June 9, 1958. 16 claims. Assigned to Bemis Bro. Bag Co. [Cl. 198-35.] Bag tubes are received from a forming machine and stacked.

Cundiff, Lester B. Dryer drum. U. S. pat. 2,919,904. Filed Aug. 6, 1956. 6 claims. Assigned to American Viscose Corp. [Cl. 257-95.] A drier roll for use in drying cellophane maintains the roll center at higher temperature than the ends.

Darnell, Ronald R. Log preloading apparatus. U. S. pat. 2,919,822. Filed July 30, 1957. 2 claims. [Cl. 214-41.] The apparatus arranges logs into an elevated truckload group for subsequent lowering into a truck.

Davidson, John T., and Howard, Charles F. Dual strip feeding mechanism. U. S. pat. 2,919,934. Filed April 9, 1954. 2 claims. Assigned to The Standard Register Co. [Cl. 282-16.] Feeding means are provided for manifold sheets in an autographic register.

Davidson, John T., and Howard, Charles F. Strip feeding device. U. S. pat. 2,919,915. Filed June 14, 1956. 8 claims. Assigned to The Standard Register Co. [Cl. 271-2.3.] Improved pin-wheel feeding means are provided for moving marginally perforated webs through a business machine.

Davidson, John T., and Staneck, Robert W. Strip feeding device. U. S. pat. 2,919,916. Filed Sept. 19, 1956. 13 claims. Assigned to The Standard Register Co. [Cl. 271-2.3.] Improved pin-wheel feeding means are provided for moving marginally perforated webs through a business machine.

Earnheart, V. J. Capping device for butter tubs. U. S. pat. 2,919,532. Filed April 10, 1957. 3 claims. [Cl. 53-310.] Closure disks are applied to round nesting container of food products, such as butter tubs.

Eilers, Ernest F., Jr. Elevated temperature and pressure two-stage hypochlorite peroxide pulp bleaching process. U. S. pat. 2,920,011. Filed March 18, 1955. 6 claims. Assigned to Waldorf Paper Prods. Co. [Cl. 162-78.]

Engle, Willy, Breuninger, Wolfgang, and Leitz, Theodor W. Thickening apparatus for fibrous suspensions. U. S. pat. 2,919,751. Filed Sept. 16, 1955. 4 claims. Assigned to J. M. Voith G.m.b.H. [Cl. 163-308.]

Farrell, Edward G. Reclosing carton. U. S. pat. 2,919,843. Filed June 27, 1958. 6 claims. [Cl. 229-17.] A paperboard carton for breakfast foods is provided with a reclosable cover and positive locking means therefor.

Fleissner, Hans. Sieve drum drying machine. U. S. pat. 2,919,496. Filed Feb. 29, 1952. 3 claims. Assigned to Fleissner & Sohn. [Cl. 34-115.]

Forrer, Homer W. Paperboard carrier incorporating a removable indicia panel. U. S. pat. 2,919,829. Filed May 13, 1957. 2 claims. Assigned to Mead Pkg. Inc. [Cl. 220-115.] A six-pack bottle carrier is provided with an extra removable display panel.

Garson, Arthur M., Gunderson, Lloyd W., and Walder, Robert J. Wrapping machine. U. S. pat. 2,919,530. Filed Feb. 20, 1959. 7 claims. [Cl. 53-182.] The machine heat-seals and wraps flat articles such as phonograph albums and cartons of tape.

Hackmyer, Saul A. Closure means for dispensing cartons. U. S. pat. 2,919,845. Filed Feb. 4, 1957. 3 claims. Assigned $^2/_3$ to Harry L. Davis and $^1/_3$ to Edward Walterman. [Cl. 229-44.] Cooperating sliding and hinged elements form a closure for a cigarette box.

Harless, Charles A. Printing machine folder. U. S. pat. 2,919,914. Filed Oct. 8, 1956. 7 claims. Assigned to R. Hoe & Co., Inc. [Cl. 270-77.]

Heppenstall, Thomas E., and Mottet, Arthur L. Felting apparatus and method. U. S. pat. 2,919,475. Filed June 15, 1953. 5 claims. Assigned to International Paper Co. [Cl. 19-155.] A mat of wood fibers, sawdust, or the like is formed.

Humphner, Ferdinand W. Decalcomania and method of using same. U. S. pat. 2,920,009. Filed March 23, 1955. 14 claims. Assigned to Minnesota Mining and Mfg. Co. [Cl. 154-95.] A paper-backed heat-responsive decal is described.

Kasten, Walter. Filter element assembly. U. S. pat. 2,919,-765. Filed Dec. 6, 1956. 9 claims. Assigned to Bendix Aviation Corp. [Cl. 183-71.] This is a pleated paper-type auto air filter.

Lejeune, Emile J. A. Machine for producing paper-pulp and like substances. U. S. pat. 2,919,863. Filed March 14, 1956. 3 claims. [Cl. 241-68.] A beating or grinding apparatus is provided for pulping or refining paper, waste paper, and other materials.

Lewis, Charles W. Electrical apparatus and solid dielectric therefor. U. S. pat. 2,920,256. Filed March 14, 1956. 6 claims. Assigned to Westinghouse Elec. Corp. [Cl. 317-258.] A dielectric material comprises cyanoethylcellulose in the form of films or coatings on paper.

McCracken, William M. Package. U. S. pat. 2,919,797. Filed Dec. 29, 1958. 7 claims. Assigned to International Resistance Co. [Cl. 206-45.34.] A slide-and-sleeve pack for electrical components is provided.

McDonald, Alexander B. Easels for holding cards, photographs, or the like. U. S. pat. 2,919,512. Filed July 21, 1953. 5 claims. [Cl. 40-152.1.] The easel is formed of paperboard and plastic elements.

Mairs, Thomas G., Locke, Frank W., and Jameson, Morton B. Paperboard display stand. U. S. pat. 2,919,815. Filed May 28, 1956. 8 claims. Assigned to Waldorf Paper Prods. Co. [Cl. 211-135.] A single paperboard blank sets up to form a multishelf display unit.

Pierce, Chester J., Jr. Device for folding and locking the

corners of a folding box blank. U. S. pat. 2,919,633. Filed May 2, 1958. Assigned to Baljak Corp. [Cl. 93-51.]

Priest, Reid G. Heel boom attachment for power shovels. U. S. pat. 2,919,823. Filed June 18, 1958. 6 claims. [Cl. 214-147.] The heel boom is for use in loading logs onto trucks and the like.

Ravis, Norman D., and Ravis, Herbert J. Phonograph record jackets. U. S. pat. 2,919,799. Filed Jan. 30, 1956. 1 claim. [Cl. 206-62.]

Rothenberger, Hansjorg. Apparatus for packing rollable containers. U. S. pat. 2,919,525. Filed Nov. 26, 1956. 13 claims. [Cl. 53-52.] Cylindrical articles such as ampoules are packaged in a box with all the labels facing in one direction.

Smith, John K., and Wilson, Matthew W. Wrapping and packaging machine. U. S. pat. 2,919,527. Filed March 31, 1958. 20 claims. [Cl. 53-66.] The machine wraps coiled metal products in paper.

Steele, Roger C. Method of expanding expandable blocks of cellular material. U. S. pat. 2,919,472. Filed May 21, 1956. 4 claims. [Cl. 18-47.5] A collapsed block of resin-impregnated paper honeycomb is expanded.

Story, Charles F. Process for humidifying hardboard. U. S. pat. 2,919,492. Filed March 15, 1957. 4 claims. Assigned to Masonite Corp. [Cl. 34-26.]

Underhay, George F., Franklin, John N., and Wells, Archibald H. Process of papermaking. U. S. pat. 2,919,495. Filed April 15, 1955. 6 claims. Assigned to The Bowater Research & Development Co. Ltd. [Cl. 34-114.] In a paper machine the web is entrained about the drying cylinders by a flow of air.

Voiret, Eugène G. Manufacture of wood pulp. U. S. pat. 2,920,010. Filed Oct. 29, 1957. 2 claims. [Cl. 162-76.] A semichemical process employs as cooking liquor a sodium sulfite solution containing sodium hydrosulfite and sodium oxalate.

Walus, Aloysius N. Coating composition comprising nitrocellulose and alkyd resin and article coated therewith. U. S. pat. 2,920,054. Filed June 14, 1956. 8 claims. Assigned to E. I. du Pont de Nemours and Co. [Cl. 260-16.] This is a metal lacquer.

White, Edward L. Packing machine. U. S. pat. 2,919,528. Filed April 17, 1958. 5 claims. [Cl. 53-124.] Loose articles are loaded into a carton, compressed, and more articles are added.

Worswick, Ronald J. Sheet distributing machine. U. S. pat. 2,919,917. Filed May 24, 1957. 3 claims. Assigned to The United States Secretary of the Air Force. [Cl. 271-64.] Sheet-feeding means are provided in a collating machine.

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Angehrn, Emile R. Display panel construction. U. S. pat. 2,290,410. Filed Sept. 11, 1957. 11 claims. [Cl. 40-126.] A collapsible assembly of paperboard elements forms a three-dimensional display representation of some article such as a bottle.

Bolger, Henry. Toilet tissue holder. U. S. pat. 2,920,833. Filed July 9, 1957. 1 claim. [Cl. 242-55.53.]

Bray, Herschel V. Cleat reinforced paperboard containers. U. S. pat. 2,920,809. Filed June 22, 1956. 3 claims. Assigned to Alton Box Board Co. [Cl. 229-49.]

Breakell, James H. Method and apparatus for drying fibrous material. U. S. pat. 2,920,397. Filed June 29, 1955. 2 claims. Assigned to American Viscose Corp. [Cl. 34-28.] Loose fibrous material is dried.

Bruce, Robert M. Integral cleat container. U. S. pat. 2,920,807. Filed April 22, 1957. 2 claims. [Cl. 229-33.] The integral cleats in a heavy-goods carton are formed by multiple folds of the paperboard, stapled together.

Butters, Otto. Carton dividers. U. S. pat. 2,920,782. Filed March 3, 1959. 7 claims. Assigned to Hunt Foods, Inc. [Cl. 217-32.] The partitions of a bottle case are cut to conserve board, while providing protection to the bottles regardless of whether they are inserted pointing up or down.

Carnes, Frank C. Cellulosic product. U. S. pat. 2,920,759. Filed May 5, 1958. 7 claims. Assigned to Kimberly-Clark Corp. [Cl. 206-56.] Packs of tissues, cigarettes, or the like are assembled in a package from which the unit packs may be removed without opening any outer carton.

Clark, James d'A. Feed mechanism. U. S. pat. 2,920,355. Filed Oct. 24, 1954. 4 claims. Assigned to Fibrofelt Corp. [Cl. 19-69.] The apparatus provided forms an even mat of fibrous material on a moving conveyor for suitable subsequent processing.

Collier, Alan. Production of hard and flexible microcrystalline waxes. U. S. pat. 2,921,012. Filed Aug. 6, 1957. 5 claims. Assigned to The Brit. Petroleum Co. Ltd. [Cl. 208-25.]

De Bell, George W. Reel apparatus. U. S. pat, 2,920,836. Filed Oct. 17, 1957. 5 claims. Assigned to The Sandy Hill Iron and Brass Works. [Cl. 242-65.] Improved roll-changing means are provided in a winder for a paper web.

Doetsch, Wilhelm. Manufacture of envelopes. U. S. pat. 2,920,539. Filed June 7, 1955. 3 claims. [Cl. 93-63.] The machine provided permits cutting blanks from a supply web at any angle of cut, or feeding them from a supply pile, to form five- or two-seal envelopes.

Dueringer, Erwin G. Reinforced plastic storage structure. U. S. pat. 2,920,810. Filed March 14, 1955. 4 claims. Assigned to A. O. Smith Corp. [Cl. 229-67.] Rings of paper are used in jointing plastic cylinders to form a storage structure.

Duke, James B. Improving clay brightness by flotation and fine grinding. U. S. pat. 2,920,832. Filed Dec. 16, 1957. 13 claims. Assigned to Minerals & Chemicals Corp. of America. [Cl. 241-23.] The clay may be used in paper coating; a tall oil-derived reagent may be used.

Fasoli, Paul A. Papermaking apparatus. U. S. pat. 2,920,-699. Filed Dec. 14, 1956. 2 claims. Assigned to The Sandy Hill Iron and Brass Works. [Cl. 162-343.] A stock flow distributor is provided for delivering stock to the headbox of a paper machine.

Fisher, Harry C., and Mather, Logan W. Procedure for making colored coated board by imprinting. U. S. pat. 2,920,991. Filed Jan. 14, 1954. 8 claims. Assigned to Diamond National Corp. [Cl. 162-134.]

Freeman, Horace, and Boadway, John D. Apparatus for separating and deaerating pulp suspension. U. S. pat. 2,920,-761. Filed Jan. 13, 1953. 1 claim. Assigned to Nichols Eng. and Research Corp. [Cl. 209-211.] A vortex-type dirt separator also removes air from paper stock.

Fry, Horace P., Jr. Apparatus for finishing cellophane. U. S. pat. 2,920,399. Filed Feb. 29, 1956. 13 claims. Assigned to American Viscose Corp. [Cl. 34-159.] A drier for a cellophane web permits one operator to control both unwind and rewind ends.

Garman, Edward B. Carton construction. U. S. pat. 2,-920,757. Filed Jan. 30, 1958. 7 claims. Assigned to Owens-Illinois Glass Co. [Cl. 206-45.21.] A shipping case for cans or bottles converts into a shelf-mountable display unit.

Gibson, William. Securing tabs for printing paper rolls. U. S. pat. 2,920,835. Filed Sept. 7, 1955. 3 claims. Assigned to The Daily Mirror Newspapers, Ltd. [Cl. 242-58.5.] A gummed paper tab is provided for securing the loose end of the paper in a newsprint roll.

Gresham, James T. Manufacture of wadding. U. S. pat. 2,920,373. Filed June 24, 1955. 2 claims. Assigned to Kimberly-Clark Corp. [Cl. 28-72.2.] A multi-ply structure of paper tissue (for insulation) is held together by a needling process.

Hauschild, William E., and Solecki, John E. Apparatus for applying pressure sensitive adhesive labels to articles. U. S. pat. 2,920,780. Filed Oct. 1, 1956. 5 claims. Assigned to Western Electric Co. [Cl. 216-9.]

Hennessey, Russell J. Floor stands. U. S. pat. 2,920,852. Filed Dec. 30, 1957. 6 claims. Assigned to Waldorf Paper Prods. Co. [Cl. 248-174.] A display bin with upright display panel, supported on an elevated base, is formed from paperboard.

Herman, Lester F. Continuous form. U. S. pat. 2,920,811. Filed Dec. 31, 1956. 3 claims. Assigned to American Lithofold Corp. [Cl. 229-69.] A continuous accordion-folded strip of foldable mailing cards is provided.

Hessburg, Lawrence J., and Rengel, Gayle L. Paper sized with fluorocarbon agents on one side and coated on the opposite side with thermoplastic materials. U. S. pat. 2,920,979. Filed Jan. 13, 1956. 7 claims. Assigned to Minnesota Mining & Mfg. Co. [Cl. 117-36.] The fluorocarbon size prevents strike through of a waxy or asphaltic coating applied on the other side.

Heywood, Vincent E. Conveying means for envelope driers. U. S. pat. 2,920,748. Filed Dec. 26, 1957. 10 claims. Assigned to U. S. Envelope Co. [Cl. 198-180.]

Hill, Howard M. Container with sanitary end closure and a method of attaching the end closure. U. S. pat. 2,920,806. Filed April 16, 1958. 2 claims. [Cl. 229-7.] A flat-top paperboard milk carton is provided with top panel closure assembly including plug-type closure cap.

Hornbostel, Lloyd. Paper machine coating arrangement. U. S. pat. 2,920, 698. Filed Oct. 12, 1955. 8 claims. Assigned to Beloit Iron Works. [Cl. 162-265.] Cast-coating is achieved on a multi-Yankee drier drum machine, with some of the drums being coated with Teflon to permit easy release of the moist web.

Hubbard, James K. Article of commerce. U. S. pat. 2,920,-992. Filed Sept. 22, 1954. 9 claims. Assigned to E. I. du Pont de Nemours & Co. [Cl. 162-157.] Paper is formed of fibers of a polymer of acrylonitrile, with the fibers being self-bonded at their points of intersection.

Kawamura, Masato. Double torpedo rodent exterminator. U. S. pat. 2,921,401. Filed Nov. 13, 1958. 6 claims. Assigned to The Lihue Plantation Co. Ltd. [Cl. 43-131.) A packet of rodent poison in waxed paper is described.

Langen, Eugen. Apparatus for the production of cellulose. U. S. pat. 2,920,697. Filed May 24, 1954. 1 claim. Assigned to Braunschweigische Maschinenbauanstalt A.G. [Cl. 162-237.]

Cellulosic materials are pulped and the pulp is washed in the same tower.

McWhorter, William E. Shipping container for fragile irregularly shaped articles. U. S. pat. 2,920,808. Filed Oct. 11, 1957. 5 claims. Assigned to Owens-Illinois Glass Co. [Cl. 229-42.]

Marle, Frederick Van. Apparatus for bundling a pile of articles, such as letters, newspapers, documents, and the like. U. S. pat. 2,920,553. Filed Dec. 10, 1956. 9 claims. Assigned to N. V. Technische Maatschappij Marchand-Andriessen. [Cl. 100-27.]

Minton, David W. Glass holding and serving tray. U. S. pat. 2,920,804. Filed July 29, 1958. 3 claims. [Cl. 229-1.5.] The tray is formed from paper or plastic.

Moynihand, John T. Paper coating composition, paper coated therewith, and method of improving the strength of paper. U. S. pat. 2,920,984. Filed March 30, 1953. 7 claims. Assigned to U. S. Secretary of Commerce. [Cl. 117-103.] The elasticity and resistance to crumpling of currency paper are improved by treating the paper with glycerol and a urea-formaldehyde resin.

Reifers, Richard F. Molded pulp fruit tray. U. S. pat. 2,920,805. Filed May 27, 1958. 1 claim. Assigned to Diamond National Corp. [Cl. 229-2.5.]

Rejsa, Jack J. Case packer. U. S. pat. 2,920,429. Filed March 8, 1957. 5 claims. Assigned to The Pillsbury Co. [Cl. 53-61.] The machine packs a shipping case with bottles or cans.

Ringler, William A. Twin-compartmented article carriers. U. S. pat. 2,920,791. Filed Nov. 15, 1956. (Divided; original filed July 7, 1954.) 7 claims. Assigned to Diamond National Corp. [Cl. 220-113.] A bottle carrier is designed to hold 12 bottles.

Sampson, George H. Calendar mount. U. S. pat. 2,920,409. Filed June 5, 1958. 4 claims. Assigned to Winthrop-Atkins Co., Inc. [Cl. 40-122.] An easel-type paperboard mount is provided for a desk calendar or the like.

Scherr, Harry. Antivesicant composition. U. S. pat. 2,921-031. Filed May 30, 1942. 6 claims. Assigned to U. S. Secretary of War as trustee. [Cl. 252-187.] Ethylcellulose is used.

Smith, Daniel W. Collecting mechanism for collating machine. U. S. pat. 2,920,888. Filed Sept. 27, 1956. 6 claims. Assigned to Halverson Prods. Mfg. Co. [Cl. 270-58.]

Thumm, Byron A. Preparing viscose rayon. U. S. pat. 2,920,973. Filed April 23, 1956. 4 claims. Assigned to American Viscose Corp. [Cl. 106-165.] The coagulation modifier is an alkylene oxide adduct of N,N'-2-ethyl butyramido ethylenediamine.

Trick, Wilkins M., Jr. Book and pamphlet holder. U. S. pat. 2,921,402. Filed May 26, 1958. 4 claims. [Cl. 45-57.] A paperboard folder is provided for supporting two books or manuscripts or the like, one of which is to be used with the other.

Wells, Roger. Pulp molding. U. S. pat. 2,920,700. Filed Sept. 28, 1956. 4 claims. Assigned to Diamond Natl. Corp. [Cl. 162-392.] The is similar to U. S. pat. 2,920,702 (Jan. 12, 1960).

Wells, Roger. Pulp molding. U. S. pat. 2,920,701. Filed Sept. 28, 1956. 4 claims. Assigned to Diamond Natl. Corp. [Cl. 162-392.] This is similar to U. S. pat. 2,920,702 (Jan. 12, 1960).

Wells, Roger. Pulp molding. U. S. pat. 2,920.702. Filed Sept. 28, 1956. 5 claims. Assigned to Diamond Natl. Corp. [Cl. 162-411.] Improved drainage means in a pulp mold prevent rewetting of the pulp preform when it is removed from the mold.

Woolworth, Richard G. Protective cover. U. S. pat. 2,920,-758. Filed Feb. 12, 1958. 8 claims. Assigned to Animal Trap Co. of Am. [Cl. 206-46.] A protective cover for an auto door is made up of a paper tube and a molded pulp sheet.

Zerlin, Hans. Method and apparatus for closing or sealing containers of paper, cardboard, or the like carton-forming material. U. S. pat. 2,920,432. Filed Feb. 11, 1958. 10 claims. Assigned to Jagenberg-Werke A.-G. [Cl. 53-371.] Gable-top milk cartons are closed and heat-sealed.

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Alger, Milton W., and Taylor, Earl M. Cardboard berry box. U. S. pat. 2,921,729. Filed May 15, 1957. 2 claims. [Cl. 229-23.]

Andrews, Sarah P. Abrasive cleaning implement. U. S. pat. 2,921,417. Filed May 28, 1958. 6 claims. [Cl. 51-185.] A device for cleaning rubber erasers comprises an abrasive element stapled within a matchbooklike paperboard folder.

Barrera, Louis A. Corrugated paper dispenser having adjustable feed rolls. U. S. pat. 2,921,491. Filed Aug. 24, 1954. 1 claim. [Cl. 83-436.]

Brebner, George B. Handled basket. U. S. pat. 2,921,730. Filed Dec. 23, 1954. 4 claims. Assigned to The Weston Paper & Mfg. Co. [Cl. 229-52.] A wire bail handle is mounted on a paperboard basket in improved manner.

Brink, Carl W., Jr., and Hobbs, Walter B., Jr. Flow diversion devices for frusto conical engines. U. S. pat. 2,921,749. Filed Sept. 29, 1955. 10 claims. Brink's interest assigned to John W. Bolton & Sons, Inc., and Hobbs' interest assigned to National Container Corp. [Cl.241-260.] Jordan refiners are provided with means to divert the stock flow along a tortuous path to ensure that all stock is treated.

Emmert, George W. Tape dispenser. U. S. pat. 2,921,493. Filed Dec. 3, 1956. 17 claims. Assigned to Federal Tool Corp. [Cl. 83-611.] Improved tape-severing means are provided.

Grand, Louis. Method of obtaining pulps usable in the papermaking or other industries, from wood or annual plants, and the pulps resulting therefrom. U. S. pat. 2,921,880. Filed Aug. 2, 1956. 4 claims. [Cl. 162-89.] The raw material is treated with caustic, then with a chlorinating solution to form pulp.

Gross, Elmer J. Carton loading and unloading device. U. S. pat. 2,921,702. Filed Nov. 16, 1956. 3 claims. Assigned to O & S Products, Inc. [Cl.214-310.] Layers of articles such as eggs on separator sheets are loaded or unloaded.

Hedlund, Harland R., and Burnham, Keith E. Carton forming machine. U. S. pat. 2,921,507. Filed July 2, 1956. 5 claims. Assigned to Waldorf Paper Prods. Co. [Cl. 93-51.] A die-and-plunger apparatus is provided for erecting self-locking paperboard trays and cartons.

Ivy, Mary E., and Burton, Drury R. Pill package. U. S. pat. 2,921,672. Filed April 30, 1956. 1 claim. Assigned to The Goodyear Tire & Rubber Co. [Cl. 206-42.] In a pill dispenser, rows of pills are sealed between a layer of film and a paperboard backing material.

Johnson, Al. Carton folding machine. U. S. pat. 2,921,506. Filed Oct. 27, 1954. 6 claims. [Cl. 93-51.] The machine folds and forms blanks into cartons of the types known as roll-over side and end locks.

Kawamura, Masato. Double torpedo rodent exterminator. U. S. pat. 2,921, 420. Filed April 22, 1959. (Divided; original filed Nov. 13, 1958.) 5 claims. Assigned to The Lihue Plantation Co. Ltd. [Cl. 53-34.] A pack of rodent poison wrapped in waxed paper is described.

Meissner, William E. Flexible sack contents extractor. U. S. pat. 2,921,718. Filed July 2, 1957. 9 claims. Assigned to American Viscose Corp. [Cl. 222-103.] A hand-operated device is provided for squeezing viscous materials from a bag in which the material is packaged.

Osipow, Lloyd I., and York, William C. Substituted carbamide detergent composition. U. S. pat. 2,921,909. Filed June 5, 1957. 10 claims. Assigned to W. R. Grace & Co. [Cl. 252-137.] Tall oil derivatives and sodium carboxymethylcellulose are used.

Ouellette, Clarence P., and Nathan, Richard T. Protector mechanism for wrapping machine. U. S. pat. 2,921,421. Filed June 17, 1957. 25 claims. Assigned to Crompton & Knowles Corp. [Cl. 53-53.] Improvements are made in a machine for wrapping food articles on a paperboard support in a paper wrapper.

Ryan, Charles. Merchandise display package. U. S. pat. 2,921,673. Filed May 28, 1954. 3 claims. Assigned to The A. C. Gilbert Co. [Cl. 206-45.31.] A sheet of plastic with article-retaining depressions slides drawerlike into a flat windowed paperboard carton.

Ryder, Fred A. Tape dispensing package. U. S. pat. 2,921,-674. Filed Feb. 11, 1957. 3 claims. Assigned to Chicago Carton Co. [Cl. 206-52.] A flat open-end carton supports a roll of masking tape or the like in rotatable dispensing position and a cutting edge for severing the tape is provided.

Schneider, Walter E., and Kufel, Stanley. Stacking machine. U. S. pat. 2.921,508. Filed July 28, 1955. 21 claims. Assigned to Congoleum-Nairn, Inc. [Cl. 93-93.] Floor tiles are counted into stacks of predetermined number in preparation for packaging each stack.

Seval, André Amand Etienne. Very high capacity boxing machine. U. S. pat. 2,921,425. Filed March 28, 1958. 4 claims. [Cl. 53-247.] The machine groups milk bottles, then cases each group.

Shaw, Fred B. Resin composition, process of making same, article impregnated therewith and process of impregnating. U. S. pat. 2,921,867. Filed March 27, 1956. 11 claims. Assigned to Continental Can Co., Inc. [Cl. 117-103.] The resin composition is for impregnating and laminating paper and the like.

Simon, Eli, and Thomas, Frank W. Package with cellular plastic packaging means. U. S. Re. pat. 24,767. Filed Jan. 10, 1958. (Divided; original filed Feb. 5, 1957.) 7 claims. Assigned to Lockheed Aircraft Corp. [Cl. 206-46.] A foamed cellular polyurethane material is used as interior packing material within a carton.

Sohn, August W. Method of producing conidendrin. U. S. pat. 2,921,879. Filed May 31, 1955. 3 claims. Assigned to Zellstoffabrik Waldhof. [Cl. 162-14.] A method of producing

conidendrin during the pulping of wood by the sulfite process is described.

Stark, William H. C., and Whittington, Kenneth W. H. Machines for lapping tape on to an electric conductor or other support. U. S. pat. 2,921,427. Filed Feb. 24, 1958. 8 claims. Assigned to Southern United Telephone Cables Ltd. [Cl. 57-15.]

Volckening, Lloyd I., O'Meara, John R., and Lefebvre, Frank J. Closed envelope package openable for inspection of contents. U. S. pat. 2,921,731. Filed July 16, 1957. 1 claim. [Cl. 229-76.]

Wesberg, Harry. Modified carboxyalkyl cellulose. U. S. pat. 2,921,934. Filed Sept. 30, 1955. 7 claims. Assigned to Londat Aetz Fabric Co. [Cl. 260-232.] Carboxymethylcellulose is treated with chromic or periodic acid to improve alkaline solubility.

Weiss, Walter J. Drilling fluid and method of use. U. S. pat. 2,921,898. Filed Dec. 4, 1957. 7 claims. Assigned to Texaco, Inc. [Cl. 252-8.5.] Sulfated ethylcellulose is used.

Wertheimer, Milton A. Package wrapping table. U. S. pat. 2,921,424. Filed Jan. 9, 1958. 4 claims. Assigned to Gellman Mfg. Co. [Cl. 53-219.] Sheets of wrapping material are movably retained on the table to facilitate their being manually wrapped about an article.

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Aldington, Elmer T. Snug fitting container closure. U. S. pat. 2,922,563. Filed Aug. 5, 1957. 6 claims. Assigned to American Can Co. [Cl. 229-43.] A snap-on paper or plastic cover is provided for a paper container of the round nesting type.

Alexander, Frank M. Measuring and controlling system. U. S. pat. 2,922,475. Filed April 9, 1958. 8 claims. Assigned to Industrial Nucleonics Corp. [Cl. 162-252.] A system is provided for controlling water removal from the paper web on the paper machine so as to provide coordination between the three major sections of the machine.

Ayers, Clarence R., Jureit, William F., and Bond, William. Record book. U. S. pat. 2,922,661. Filed Oct. 4, 1956. 2 claims. [Cl. 282-22.] A loose-leaf binder holding business form sheets is described.

Bland, Percy N. Chipper knife supporting means. U. S. pat. 2,922,590. Filed April 7, 1955. 2 claims. Assigned to Canadian Sumner Iron Works, Ltd. [Cl. 241-92.]

Boyle, William C. Machine for making book covers. U. S. pat. 2,922,172. Filed July 5, 1957. 1 claim. Assigned to General Box Co. [Cl. 11-2.]

Büttner, Artur. Sheet feeding apparatus. U. S. pat. 2,922,-647. Filed March 25, 1958. 4 claims. Assigned to Schnellpressenfabrik A.G. Heidelberg. [Cl. 271-62.] A printing press sheet-feeder of the pile elevating type is described.

Büttner, Artur. Sheet feed apparatus driving mechanisms. U. S. pat. 2,922,646. Filed March 25, 1958. 12 claims. Assigned to Schnellpressenfabrik A.G. Heidelberg. [Cl. 271-54.] Improved drive means are provided for effecting the reciprocating movement of the gripper carriage of a printing press sheet-feeder.

Chalmers, John W., and Jackson, Donald R. P. Feeding of webs or strips of flexible material. U. S. pat. 2,922,342. Filed Sept. 11, 1956. 16 claims. Assigned to Molins Machine Co., Ltd. [Cl. 93-1.] A cigarette wrapper and tear strip are assembled.

Currivan, John F. Cartons. U. S. pat. 2,922,561. Filed Nov. 1, 1956. 3 claims. Assigned to Carton Associates, Inc. [Cl. 229-40.] Improved means are provided to retain the cans in a six-pack open-end carrier.

Dereich, John E. Method of preparing laminated paperboard by treating paper with aqueous solution of a silicate and a sucrose modified urea-formaldehyde resin. U. S. pat. 2,922,729. Filed April 13, 1953. 9 claims. Assigned to Diamond Alkali Co. [Cl. 117-155.]

Dohmen, Heinrich. Process for the manufacture of coal briquettes. U. S. pat. 2,922,704. Filed Oct. 20, 1955. 7 claims. Assigned to N. V. Briko. [Cl. 44-15.] The binder used is prepared by reacting acetic acid with starch, dextrin, methylcellulose, or carboxymethylcellulose.

Dungler, Julien. Process for the treatments performed with gasiform corrosive fluids chiefly adapted for textile, paper, and the like industries. U. S. pat. 2,922,695. Filed Nov. 15, 1954. 2 claims. [Cl. 8-149.3.] Chlorine dioxide bleaching is accomplished in a dry atmosphere to reduce equipment corrosion.

Dunlap, Charles K., Jr., Turnage, Richard W., and Whaley, Baynard R. Means for forming a spiral wound paper tube structure. U. S. pat. 2,922,343. Filed Jan. 10, 1958. 4 claims. Assigned to Sonoco Products Co. [Cl. 93-80.]

Fornell, David E., and Fornell, Bertil S. Collating machine. U. S. pat. 2,922,640. Filed July 15, 1953. 14 claims. [Cl. 270-58.]

Habgood, Warren J. Machine for taping objects on cards. U. S. pat. 2,922,265. Filed Dec. 23, 1957. 32 claims. [Cl. 53-73.]

Haffner, Fred G. Conveying apparatus. U.S. pat. 2,922,266. Filed May 17, 1956. 2 claims. Assigned to Pneumatic Scale Corp., Ltd. [Cl. 53-387.] The conveyor holds sealed carton flaps in position until the adhesive sets.

Harker, Charles B. Package for tobacco or the like. U. S. pat. 2,922,568. Filed March 1, 1954. 3 claims. Assigned to Bartelt Eng. Co. [Cl. 229-62.] Tobacco is packed in a foil pouch sealed in a paperboard carton.

Höller, Hans, and Breidenbach, Josef. Machine for periodic strip feed. U. S. pat. 2,922,641. Filed Sept. 26, 1956. 12 claims. Assigned to Maschinenfabrik Gebrüder Höller Offene Handelsgesellschaft. [Cl. 271-2.6.] A web of preprinted paper is fed intermittently through a bag machine with proper register.

Hoesch, Robert. Vibratory material comminutor. U. S. pat. 2,922,588. Filed Feb. 16, 1956. 9 claims. [Cl. 241-46.] Paper pulp fibers are fibrillated in an apparatus which subjects them to a pure crushing action only.

Hopkins, Robert P., and Young, Harold C. Fiber-reinforced resin-bearing tissues, films or sheets, and articles obtained therefrom. U. S. pat. 2,922,732. Filed Dec. 11, 1956. 16 claims. Assigned to Rohm & Haas Co. [Cl. 154-46.] A wet-strength tissue carries an interfiber deposit of particles of a thermoplastic resin, and may be used as a laminating sheet, etc.

Johnstone, Henry F. Method of producing pulping liquor. U. S. pat. 2,922,735. Filed Dec. 18, 1956. 8 claims. Assigned to Texas Gulf Sulphur Co. [Cl. 162-83.] Sulfur dioxide is removed from flue gases from the burning of coal and used in forming sulfite cooking liquor.

Jones, Lester M. Method and apparatus for de-aerating bags during filling. U. S. pat. 2,922,443. Filed Nov. 5, 1956. 6 claims. [Cl. 141-7.]

Kernan, James M. Method and apparatus for determining opening force characteristics for flat-folded carton blanks. U. S. pat. 2,922,302. Filed Jan. 17, 1956. 8 claims. Assigned to Packaging Corp. of America. [Cl. 73-88.]

Kessler, Theodore P. Shipping carton for plush. U. S. pat. 2,922,516. Filed May 8, 1956. 15 claims. Assigned to Timron Development and Mfg. Corp. [Cl. 206-51.] In the carton provided, the fabric is reeled so that the convoluted layers are out of contact with each other.

Kiefer, Erich. Apparatus for drying loose fibrous materials and the like. U. S. pat. 2,922,229. Filed March 28, 1957. 2 claims. [Cl. 34-115.] A multidrum drier is described.

Kleineberg, Paul E., and Roseman, Joseph C. Controlled hopper feed for independently driven trimmer in book-binding system. U. S. pat. 2,922,171. Filed Aug. 14, 1957. 5 claims. Assigned to T. W. & C. B. Sheridan Co. [Cl. 11-1.]

Koxvold, Leif F. Apparatus for producing hollow articles by dewatering fiber pulp. U. S. pat. 2,922,476. Filed April 10, 1954. 4 claims. [Cl. 162-392.] An elastic plunger is used to help dewater a molded pulp flower pot supported in the forming mold.

Lavanchy, Patricia B. Product and method of manufacture. U. S. pat. 2,922,723. Filed Jan. 31, 1957. 15 claims. Assigned to Johnson & Johnson. [Cl. 117-76.] A primer coating for use in making pressure-sensitive tape includes an elastomer and an ethylene imino compound.

Lopez, John P. Sheet feeding equipment. U. S. pat. 2,922,-643. Filed Aug. 8, 1957. 1 claim. Assigned to Universal Corrugated Box Machinery Corp. [Cl. 271-35.] Sheets of corrugated or the like are fed to a boxmaking machine from the bottom of a supply stack.

McDermott, Martin A. Inventory storage container. U. S. pat. 2,922,567. Filed July 23, 1957. 5 claims. [Cl. 229-52.] A paperboard container, open on two adjacent sides and having built-in wire hanger hooks provided, is designed for use in a monorail storage system.

Midnight, Wilbur G. Container. U. S. pat. 2,922,560. Filed July 15, 1955. 5 claims. [Cl. 229-33.] A reinforced multiwall carton with integral cover is provided for packaging heavy articles such as welding electrodes.

Pellaton, Ernest C. Polygonal carton construction. U. S. pat. 2,922,562. Filed June 20, 1958. 13 claims. Assigned to Fibreboard Paper Prods. Corp. [Cl. 229-41.] A hexagonal paperboard carton is designed to be collapsible and to have an automatic bottom construction.

Perry, Arthur G., and Gilfix, Philip. Controlled density cushioning. U. S. pat. 2,922,559. Filed Oct. 23, 1957. 4 claims. Assigned to Lelanite Corp. [Cl. 229-14.] Coils of rubberized fiber are used as interior packaging in containers for fragile instruments or the like.

Perzentka, Thomas R. Sheet separating mechanism for duplicators. U. S. pat. 2,922,644. Filed April 25, 1957. 8 claims. Assigned to A. B. Dick Co. [Cl. 271-39.]

Petley, Joseph E. Electric capacitor and stabilized dielectric material therefor. U. S. pat. 2,922,938. Filed June 24, 1954. 6 claims. Assigned to General Electric Co. [Cl. 317-259.] The paper spacer element is impregnated with a liquid including an organo-siloxane and a ketone such as anthraquinone.

Radley, Sidney A. Automatic inspection and rejection means. U. S. pat. 2,922,519. Filed Dec. 5, 1957. 3 claims. Assigned to Industrial Nucleonics Corp. [Cl. 209-111.] A system for packaging filter-tip cigarettes is provided with means to detect and reject any cigarette which is missing the filter tip.

Roderick, Wayne J., and Huffman, Oscar J., Jr. Top-opening paperboard container. U. S. pat. 2,922,565. Filed Dec. 23, 1957. 2 claims. Assigned to Alton Box Board Co. [Cl. 229-44.] A paperboard carton with hinged top cover is designed for use as a letter file.

Spalding, Donald H. Method of controlling slime by treating with a 2-allyl-chlorophenol. U. S. pat. 2,922,736. Filed Dec. 5, 1956. 9 claims. Assigned to Dow Chemical Co. [Cl. 162-161.] Slime in papermaking systems is controlled.

Standal, George M. Cutters for planer chipper woodworking machines. U. S. pat. 2,922,448. Filed Jan. 26, 1959. 5 claims. [Cl. 144-219.] In a lumber planer, the outer portion of the wood cut away is removed in the form of chips cut transversely to the wood grain.

Van Rosen, Robert E. Box or container. U. S. pat. 2,922,564. Filed Aug. 9, 1956. 2 claims. [Cl. 229-44.] A flip-top box is provided for use in packaging cigarettes, cigars, etc.

Whelan, James P. Infusion bag. U. S. pat. 2,922,717. Filed Sept. 14, 1956. 4 claims. Assigned to Pneumatic Scale Corp., Ltd. [Cl. 99-77.1.] A tea bag is constructed to comprise two half sections folded together.

White, Guy H., Jr. Prevention of yellowing in freshly spun viscose rayon with tartaric, citric or gluconic acid. U. S. pat. 2,922,728. Filed Nov. 5, 1956. 8 claims. Assigned to American Enka Corp. [Cl. 117-139.5.]

Wright, William W. Closure and carrying means for boxlike containers. U. S. pat. 2,922,566. Filed Aug. 2, 1957. 2 claims. [Cl. 229-46.] A piece of cord is arranged to act as handle and cover-locking means for a shoebox.

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Allen, Kenneth V. Seed planting mat. U. S. pat. 2,923,093. Filed April 11, 1958. 7 claims. Assigned to Troy Blanket Mills. (Cl. 47-56.] The mat includes a core layer of seed in growing media, together with fibrous mats as facing layers.

Campbell, Norman B., and Berthiaume, Laurent. Manufacture of cellulose esters of aliphatic acids. U. S. pat. 2,923,706. Filed June 22, 1955. 6 claims. Assigned to Canadian Celanese Ltd. [Cl. 260-229.]

Chaplin, Oliver F. Folded paper products and dispenser therefore. U. S. pat. 2,923,435. Filed Nov. 14, 1955. 7 claims. Assigned to Crown Zellerbach Corp. [Cl. 221-47.] Paper towels are folded so that they may be withdrawn from a stack of the towels without interfolding of the towels.

Comstock, Alfred E. Apparatus and method for forming apertures in molded pulp articles. U. S. pat. 2,923,654. Filed Jan. 6, 1955. 14 claims. Assigned to Diamond Natl. Corp. [Cl. 162-228.] Egg cartons are formed with apertures of use in locking the carton.

Cook, Clayton M., and Moser, Charles E. Hemostatic product. U. S. pat. 2,923,664. Filed Sept. 11, 1957. 4 claims. Assigned to Johnson & Johnson. [Cl. 167-82.] A surgical pellet is formed of fibrous carboxymethylcellulose bonded with sodium carboxymethylcellulose.

Dockstader, Wilmer B., and Thoennes, Lawrence A. Unitary nonadherent dressings. U. S. pat. 2,923,298. Filed Dec. 10, 1954. 6 claims. Assigned to Kendall Co. [Cl. 128-296.] The dressing comprises cellulose wadding to which is adhered a perforated plastic film.

Eckman, George E. Container and process for sealing the same. U. S. pat. 2,923,453. Filed Nov. 30, 1956. 2 claims. Assigned to American Can Co. [Cl. 229-43.] Emplacement of the cover onto a traylike container of frozen food produces a partial vacuum in the headspace of the container.

Gerard, George. Rip string heavy duty paper bag. U. S. pat. 2,923,457. Filed Oct. 28, 1954. 2 claims. Assigned to Jiffy Mfg. Co. [Cl. 229-66.]

Graf, George L., Jr. Composition and method for impregnation of sheet materials with synthetic resin latices utilizing coagulants of water-soluble amine or quaternary ammonium salts. U. S. pat. 2,923,641. Filed April 18, 1955. 9 claims. Assigned to The Celastic Corp. [Cl. 117-65.] Paper and the like are stiffened for use in making shoes.

Hagar, John F. Display and carrying package for merchandise. U. S. pat. 2,923,401. Filed Nov. 9, 1956. 5 claims. Assigned to Diamond National Corp. [Cl. 206-45.33.] An article is mounted on a card and the assembly enclosed in a film envelope with a portion of the card protruding as a handle.

Hankus, Chester P. Packaging device. U. S. Re. pat. 24,774. Filed June 29, 1959. 3 claims. Assigned 65% to Chester P. Hankus, 10% to Peter Van Beek, 10% to Theodore Hankus, and 15% to Kenneth T. Snow. [Cl. 206-65.] The carton described safely supports the fragile limbs of an artificial Christmas tree.

Harker, Charles B. Machine for filling and closing cartons U. S. pat. 2,923,112. Filed Dec. 1, 1954. 19 claims. Assigned to Bartelt Eng. Co. [Cl. 53-58.]

Hein, Kenneth L., and Lindsey, David L. Drilling fluids and compositions for use in modification of same. U. S. pat. 2,923,681. Filed April 23, 1954. 6 claims. [Cl. 252-8.5.] The additives include quebracho, tannins, and lignins from spent pulping liquors.

Himmelheber, Max, Kull, Walter, and Steiner, Klaus. Methods and apparatus for producing pressed wood-particle panels. U. S. pat. 2,923,030. Filed Oct. 5, 1953. 15 claims. Assigned to Allwood Inc. [Cl. 18-4.]

Hoiberg, Arnold J., and Cowger, Charles E. Asphalt adhesive composition. U. S. pat. 2,923,638. Filed May 14, 1956. 1 claim. Assigned to Monsanto Chemical Co. [Cl. 106-278.] An asphalt adhesive is provided for laminating aluminum foil to roofing paper.

Jordan, Arthur D., Jr. Release-coatings film- and sheetcasting bases for substrates. U. S. pat. 2,923,646. Filed Dec. 12, 1957. 6 claims. Assigned to Rohm & Haas Co. [Cl. 117-155.] A release coating is applied to a paper base to form a casting surface for forming plastic films, or for other purposes.

Klausmann, Milton H. Container and combined cover and pouring spout. U. S. pat. 2,923,445. Filed Oct. 8, 1958. 3 claims. Assigned to Seal-Spout Corp. [Cl. 222-531.] A carton for granular substances is provided with an extra-wide pouring spout.

Leitzel, Ammon M. Apparatus for molding pulp articles having apertures formed thereon. U. S. pat. 2,923,352. Filed Jan. 31, 1955. 7 claims. Assigned to Diamond Natl. Corp. [Cl. 162-383.]

Lemke, Warren A. Adhesive comprising dried sulphite waste material, polyacrylamide, filler and alkaline material. U. S. pat. 2,923,693. Filed Aug. 2, 1954. 1 claim. Assigned to International Paper Co. [Cl. 260-17.5.]

Marogg, Richard. Apparatus for forming perforations in paper by abrasion. U. S. pat. 2,923,052. Filed Dec. 21, 1955. 10 claims. Assigned to Kimberly-Clark Corp. [Cl. 29-76.]

Miller, Robert K. Novel formyloxetanes and process of preparing same. U. S. pat. 2,923,645. Filed Jan. 19, 1959. 6 claims. Assigned to E. I. du Pont de Nemours & Co. [Cl. 117-139.4.] The compounds are for use in dimensionally stabilizing cellulosic fibrous material.

Miller, Roland E., and Rudnik, Raymond G. Packaging apparatus. U. S. pat. 2,923,114. Filed April 15, 1957. 4 claims. Assigned to National Dairy Prods. Corp. [Cl. 53-112.] Air is evacuated from a carton holding several film-wrapped wedges of cheese.

Munger, Stanley H. Preparation of photopolymerizable compounds. U. S. pat. 2,923,673. Filed May 21, 1958. 14 claims. Assigned to E. I. du Pont de Nemours and Co. [Cl. 204-158.] The compounds are for use in making printing plates; cellulose esters are used.

Nicholson, Thomas W. Centering log-barker roll hold-down. U. S. pat. 2,923,333. Filed Sept. 28, 1956. 16 claims. [Cl. 144-249.]

Pupke, Henry W. Cartons. U. S. pat. 2,923,454. Filed March 22, 1954. 7 claims. Assigned to National Biscuit Co. [Cl. 229-51.] A pasted-closure carton for soda crackers is provided with means for reclosing the cover flap after it has once been cut open.

Ryan, Maurice A. Quick-opening pasted multiwall paper bag. U. S. pat. 2,923,456. Filed Jan. 27, 1956. 2 claims. Assigned to International Paper Co. [Cl. 229-55.]

Schwebs, Robert K. Box and method and apparatus for the manufacture thereof. U. S. pat. 2,923,211. Filed Aug. 12, 1957. 11 claims. Assigned to Cornell Paperboard Products Co. [Cl. 93-36.] A display box includes a bottom member, a body portion with window-forming top flaps, and a film wrapper.

Selock, Dean P. Packaging machine. U. S. pat. 2,923,111. Filed July 14, 1954. 16 claims. Assigned to Roto Wrap Machine Corp. [Cl. 53-29.] Paper bags are formed, filled, sealed, and delivered.

Tamarin, Bernard J. Method and apparatus for producing a cigarette package with tear tab opening means. U. S. pat. 2,923,110. Filed July 21, 1958. (Divided; original filed June 10, 1953.) 7 claims. [Cl. 53-14.]

Thumm, Byron A. Viscose solution. U. S. pat. 2,923,637. Filed June 24, 1957. (Divided; original filed Nov. 3, 1954.) 2 claims. Assigned to American Viscose Corp. [Cl. 106-165.] The coagulation modifier is an alkylene oxide adduct of aniline.

Tingley, William E. Tapered carton with handle. U. S. pat. 2,923,455. Filed Aug. 19, 1958. 3 claims. Assigned to American Can Co. [Cl. 229-52.]

Wands, Howard G., and McPherson, Alexander L. Multiple unit mat winding machine. U. S. pat. 2,923,487. Filed Dec. 31, 1956. 20 claims. Assigned to Gustin-Bacon Mfg. Co. [Cl. 242-55.1.]

Wells, Roger. Drying die. U. S. pat. 2,923,068. Filed Jan.

13, 1958. 2 claims. Assigned to Diamond National Corp. [Cl. 34-104.]

Wells, Roger. Metal sandwich mold. U. S. pat. 2,923,353. Filed Jan. 28, 1958. 3 claims. Assigned to Diamond Natl. Corp. [Cl. 162-411.] A mold for forming molded pulp articles is increased in strength.

Worth, Francis C. Marking apparatus. U. S. pat. 2,923,232. Filed Nov. 28. 1958. 19 claims. Assigned to Adolph Gottscho, Inc. [Cl. 101-35.] Cartons are imprinted as they are moved along a processing line.

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Collins, Thurmon L. Process for treating wire screen. U. S. pat. 2,924,536. Filed Nov. 3, 1958. 3 claims. Assigned to Masonite Corp. [Cl. 117-43.] A wire screen of the type used with each platen in a hardboard hot press is treated to increase its peripheral thickness.

Cotton, William A. Process for making laminated hardboard product. U. S. pat. 2,924,548. Filed July 16, 1956. 4 claims. Assigned to Masonite Corp. [Cl. 162-132.]

Dereich, John E. Resinous flameproofing composition. U. S. pat. 2,924,532. Filed Sept. 9, 1957. 5 claims. Assigned to Diamond Alkali Co. [Cl. 106-15.] Cellulosic materials are flameproofed with a composition including chlorinated paraffin wax and an aliphatic antimonyl compound.

Ditzel, Johannes. Dispensing device for strip material. U. S. Re. pat. 24,778. Filed June 4, 1958. 12 claims. [Cl. 271-2.4.] Tapes of predetermined lengths are automatically dispensed from the device, for use in packaging applications.

Di Vozzi, Frank. Toy case. U. S. pat. 2,924,373. Filed April 3, 1957. 5 claims. Assigned to Hassenfeld Bros., Inc. [Cl. 229-44.] A toy suitcase is formed of paperboard.

Erickson, Harold E., Riley, Robert W., and Schubert, Dale L. Prepressing and dividing particle mats. U. S. pat. 2,923,968. Filed May 17, 1956. 5 claims. Assigned 50% to Industrial Development Co. and 50% to Dale L. Schubert. [Cl. 18-4.]

Erickson, Harold E., Riley, Robert W., and Schubert, Dale L. Prepressing and dividing particle mats. U. S. pat. 2,923,974. Filed May 3, 1957. (Divided; original filed May 17, 1956.) 4 claims. Assigned 50% to Dale L. Schubert and 50% to Industrial Development Co. [Cl. 18-17.]

Frankenstein, William P. Carton. U. S. pat. 2,924,-371. Filed Oct. 8, 1956. (Divided; original filed June 18, 1951.) 6 claims. [Cl. 229-31.] A carton with hinged windowed cover includes a raised platform for supporting the goods to be packaged.

Friedman, Alex. Method of molding resin and fiber compositions. U. S. pat. 2,924,550. Filed June 25, 1956. 5 claims. [Cl. 162-224.] A molded pulp preform is held on a loose wire mesh during drying and final consolidation.

Henriksen, Arthur L. Method and apparatus for sealing bags. U. S. pat. 2,924,196. Filed Dec. 23, 1957. 3 claims. Assigned to Norsk Hydro-Elektrisk Kvaelstofaktieselskab. [Cl. 118-423.] The stitched seams of a bag are passed through a wax bath.

Hoey, Raymond M. Adhesive bandage envelope. U. S. pat. 2,924,331. Filed Oct. 5, 1955. 6 claims. Assigned to The Kendall Co. [Cl. 206-63.2.] An easy-opening paper envelope for a band-aid is provided.

Imholf, Alfred. Laminated body and method of making the same. U. S. pat. 2,924,264. Filed July 18, 1955. 26 claims. Assigned to Moser-Glaser & Co. A. G. [Cl. 154-2.6.] Sheets of paper are impregnated with a liquid dielectric and laminated with a thermosetting resin.

Kirkeby, David H. Lap tray-container. U. S. pat. 2,924,-372. Filed Nov. 19, 1956. 6 claims. Assigned to Lyman D. Dunn. [Cl. 229-34.]

Klein, Caspar, and Podschus, Ernst. Paper containing an organic fluorescent dye. U. S. pat. 2,924,549. Filed Dec. 15, 1955. 13 claims. Assigned to Farbenfabriken Bayer A.G. [Cl. 162-162.] A siliceous pigment is also included.

Knapp, Samuel B., and Wethern, James D. Rapid neutral sulfite process for pulping bagasse and other nonwoody plant lignocellulose. U. S. pat. 2,924,547. Filed Nov. 8, 1954. 14 claims. Assigned to Hawaiian Devt. Co., Ltd. [Cl. 162-83.]

Lemon, Cecil G. Cartons. U. S. pat. 2,924,370. Filed July 12, 1957. 3 claims. Assigned to Unipak Carton Ltd. [Cl. 229-28.] Internal cells in a collapsible paperboard carton are held in alignment by locking means.

Lloyd, Allen H. Box setting up machine. U. S. pat. 2,-924,156. Filed May 24, 1954. 12 claims. Assigned to Tech-Art Inc. [Cl. 93-49.] Flat traylike cartons, which may have hollow side walls, are erected.

Lord, Henry A., and Crane, Harold S. Egg carton. U. S. pat. 2,924,368. Filed July 1, 1957. 3 claims. Assigned to Diamond National Corp. [Cl. 229-2.5.]

Lord, Henry A., and Crane, Harold S. Molded egg carton. U. S. pat. 2,924,367. Filed May 1, 1957. 1 claim. Assigned to Diamond National Corp. [Cl. 229-2.5.]

MacEvoy, Walter M. Apparatus for interleaving bags made of a thermoplastic material. U. S. pat. 2,924,454. Filed Jan. 25, 1957. 11 claims. [Cl. 271-83.] In a bagmaking machine, the heat-sealed seams of the bags are held out of contact with other bags until the seal has solidified.

More, Arthur R. Method of and means for packaging articles. U. S. pat. 2,924,051. Filed April 22, 1957. 20 claims. Assgined to H. W. Wallace & Co., Ltd. [Cl. 53-26.] Packets are grouped and each group loaded into a carton.

Nadelman, Alfred H. Dense papers and process for preparing them. U. S. pat. 2,924,538. Filed April 16, 1956. 8 claims. Assigned to Allied Chem. Corp. [Cl. 117-65.] Oxidized polyethylene is applied to the paper, and the paper is then wet-calendered.

Peyrebrune, Henri E. Delivery sheet slow down mechanism. U. S. pat. 2,924,453. Filed May 24, 1957. 4 claims. Assigned to Miehle-Goss-Dexter, Inc. [Cl. 271-79.] A printing press delivery mechanism slows down each sheet for deposit onto a delivery pile.

Preble, Harry, Jr. Multiple roll dispenser for flexible sheets. U. S. pat. 2,924,493. Filed Feb. 21, 1955. 4 claims. Assigned to National Can Corp. [Cl. 312-39.] A dispensing cabinet holds several rolls of web material and dispenses each separately of the others.

Rambold, Adolf G. F. Apparatus for applying staples to tea bags and the like. U. S. pat. 2,923,936. Filed Nov. 30, 1956. (Divided; original field March 14, 1952.) 10 claims. Assigned to Teepack Spezialmaschinen. [Cl. 1-2.]

Richter, Donald L. Metallic receptacles. U. S. pat. 2,924,-369. Filed Aug. 17, 1955. 7 claims. Assigned to Kaiser Aluminum & Chem. Corp. [Cl. 229-3.5.] Containers of satisfactory strength properties are formed from very thin sheet material such as thin-gage aluminum foil.

Rigolini, Vinnie J. Apparatus for shaping and affixing pliable material to a support. U. S. pat. 2,924,155. Filed June 18, 1958. 25 claims. Assigned to Whitehouse Products, Inc [Cl. 93-1.] A plastic label holder is formed and fixed to an index card or file folder.

Rossiter, Goeffrey W. Display and amusement devices. U. S. pat. 2,924,036. Filed Oct. 21, 1952. 5 claims. [Cl. 40-138.] A group of cardboard profile figures is connected and suspended in balanced arrangement by lengths of thread to form a mobile.

Russell, John K., and Boggs, Walter W. Method and apparatus for crumpling paper. U. S. pat. 2,924,154. Filed Aug. 27, 1956. 15 claims. Assigned to Luber-Finer, Inc. [Cl. 93-1.] Sheets of paper are crumpled into wads for use in filtering engine oils.

Shell, Francis J., and Still, Robert D. Composition comprising cement methyl siliconate salt and cellulose ether method of making and process of employing same. U. S. pat. 2,924,277. Filed March 25, 1954. 10 claims. Assigned to Phillips Petroleum Co. [Cl. 166-33.] Cellulose derivatives are used in formulating a hydraulic cement.

Sloier, Harold E. Towel dispenser and keyed supply roll. U. S. pat. 2,924,494. Filed Oct. 8, 1956. 10 claims. Assigned to Shore-Calnevar, Inc. [Cl. 312-39.] A paper towel dispenser accepts only those supply rolls which have a suitable keyed hole formed radially in the roll.

Vineberg, Joseph H. Bag and handle structure therefor. U. S. pat. 2,924,374. Filed Aug. 12, 1957. 1 claim. [Cl. 229-54.] An element formed of paper or board is attached to a paper shopping bag to act as a handle and closing device for the bag mouth.

Vogt, Clarence W. Tape disensing and cutting device. U. S. pat. 2,924,366. Filed Jan. 7, 1955. 12 claims. [Cl. 225-66.]

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Anderson, James L., and Anderson, Lewis F. Wheeled vehicle. U. S. pat. 2,925,186. Filed Dec. 19, 1958. 1 claim. [Cl. 214-506.] A wheeled vehicle or cart is provided for transporting a pallet holding small logs.

Basta, Lawrence E. Method of making hair curling tube. U. S. pat. 2,925,021. Filed Aug. 22, 1958. 2 claims. [Cl. 93-94.] The tube is formed from paper.

Beusker, Geradus H., and Schneider, Friedrich A. Separator for electric accumulators. U. S. pat. 2,925,456. Filed May 14, 1956. 13 claims. Assigned to Accumulatorenfabriek "Varta" N.V. [Cl. 136-145.] The separator has a paper core faced on one side with glass fiber matting and on the other side with polyvinyl chloride or hard rubber.

Brookshier, James W. Piercing and tapping device for fluid filled film containers. U. S. pat. 2,925,199. Filed April 18, 1956. 2 claims. Assigned to B-Line Dispensers, Inc. [Cl. 222-91.] A tapping device is provided for dispensing the

contents of a container comprising an inner polyethylene bag within an outer carton.

Bryce, Robert S., and Griggs, William H. Photographic stripping paper. U. S. pat. 2,925,340. Filed Jan. 7, 1957. 2 claims. Assigned to Eastman Kodak Co. [Cl. 96-83.]

Candido, Michael, Jr. Apparatus for opening and unloading cartons. U. S. pat. 2,925,185. Filed April 4, 1957. 11 claims. Assigned to Chas. Pfizer & Co., Inc. [Cl. 214-304.] The apparatus opens the lower flaps of cartons containing bottles or the like, then dumps the contents of the cartons.

Crawford, Earl A. Machine for printing webs of paper base and similar fibrous web materials. U. S. pat. 2,925,034. Filed Dec. 21, 1956. (Divided; original filed April 29, 1953.) 13 claims. Assigned to Bird and Son, Inc. [Cl. 101-157.]

Crawford, Earl A. Register producing means for a roller printing machine. U. S. pat. 2,925,035. Filed Dec. 21, 1956. (Divided; original filed April 29, 1953.) 2 claims. Assigned to Bird & Son, Inc. [Cl. 101-181.]

Crawford, Earl A. Web feeding and printing mechanism for multiple unit roller type printing machine. U. S. pat. 2,925,-036. Filed Dec. 21, 1956. (Divided; original filed April 29, 1953.) 2 claims. Assigned to Bird & Son, Inc. [Cl. 101-182.]

Dillingham, Frederick L. Log-debarking head mounted on traveling carriage and pivotable about two mutually transverse axes. U. S. pat. 2,925,106. Filed Aug. 23, 1956. (Divided; original field Feb. 23, 1954.) 12 claims. Assigned to Soderhamn Machine Mfg. Co. [Cl. 144-208.] Improved means are provided for traversing the barking head of a flail-type barker.

Eaton, Lewis B. Infusion bag and method of making the same. U. S. pat. 2,925,171. Filed Oct. 13, 1958. 18 claims. Assigned to Pneumatic Scale Corp., Ltd. [Cl. 206-5.] Thermoplastic fibers are used only in the margins of the bag, in the heat-sealed areas.

Eisele, Julius, Federkiel, Wilhelm, Schuster, Curt, and Maier, Karl. Process of dyeing and printing cellulose derivatives. U. S. pat. 2,925,314. Filed Sept. 16, 1955. 15 claims. Assigned to Badische Anilin- & Soda-Fabrik A.G. [Cl. 8-85.]

Faeber, Harry W. Jogger mechanism-signature delivered to stacking mechanism individually. U. S. pat. 2,925,271. Filed Dec. 13, 1955. 11 claims. Assigned to Time, Inc. [Cl. 271-87.]

Fallert, Clifford D. Heavy-duty container for bulk material. U. S. pat. 2,925,210. Filed Oct. 8, 1956. 1 claim. Assigned to Crown Zellerbach Corp. [Cl. 229-23.] A bulk paperboard container for shipping up to 500 lb. of flour or the like is provided.

Fitzwater, Bruce E. Annular debarking mechanism and control. U. S. pat. 2,925,107. Filed May 6, 1958. 17 claims. Assigned to L-M Equipment Co. [Cl. 144-208.] Improved log-centering means are provided.

Frankenstein, William P. Carton. U. S. pat. 2,925,211. Filed May 27, 1954. 3 claims. [Cl. 229-34.] A one-piece collapsible traylike carton having hollow wide walls is provided.

Hollis, Robert F. Web feed apparatus. U. S. pat. 2,925,270. Filed March 14, 1957. 4 claims. Assigned to Alton Box Board Co. [Cl. 271-2.2.] Web tension control and butt splicing means are provided in a printer and blanker operating on paperboard webs in making boxes.

Jensen, Thormod. Floating mounting for a laminating roll. U. S. pat. 2,925,118. Filed Oct. 7, 1957. 4 claims. Assigned to St. Regis Paper Co. [Cl. 154-37.]

Johnston, David R. Manufacture of organic substances of very high molecular weight. U. S. pat. 2,925, 412. Filed March 18, 1954. 9 claims. Assigned to British Celanese Ltd. [Cl. 260-230.] A process for separating cellulose esters from solution is described.

Johnston, David R. Manufacture of organic substances of very high molecular weight. U. S. pat. 2,925,413. Filed Feb. 25, 1955. 8 claims. Assigned to British Celanese Ltd. [Cl. 260-230.] A process for separating cellulose esters from solution is described.

Johnston, David R. Manufacture of very high molecular weight organic substances. U. S. pat. 2,925,414. Filed March 4, 1955. 13 claims. Assigned to British Celanese, Ltd. [Cl. 260-230.] A process for separating cellulose esters from solution is described.

Lundberg, Don. Master sheet set for spirit duplicating. U. S. pat. 2,925,033. Filed Nov. 5, 1956. 1 claim. Assigned to Old Town Corp. [Cl. 101-149.4.] Bleeding of the carbon and smudging of the master are provided.

Mika, John P., and Hughes, Harold K. Solutions of organic acid esters of cellulose. U. S. pat. 2,925,353. Filed Aug. 18, 1954. 11 claims. Assigned to Celanese Corp. of America. [Cl. 106-198.] A cellulose ester solution is subjected to high shear to improve filterability and spinnability.

Riker, Charles O. Control mechanism for boxmaking machines. U. S. pat. 2,924,825. Filed Feb. 13, 1959. 4 claims. Assigned to Stapling Machines Co. [Cl. 1-147.] A machine for stapling the various sections of a wire-bound box together is provided with control means for adjusting the position of the staples.

Roberts, James R., and Collins, Ernest H. Method of preventing excessive springback of dry felted fiber mats. U. S. pat. 2,925,360. Filed Aug. 29, 1957. 3 claims. Assigned to Weyerhaeuser Co. [Cl. 154-101.] Mats for making hardboard are heated with dry steam before the precompressing or cold-pressing step.

Roscoe, Howard E. Apparatus for making regenerated cellulose film. U. S. pat. 2,925,088. Filed June 23, 1958. 3 claims. Assigned to E. I. du Pont de Nemours and Co. [Cl. 134-64.]

Stoner, Harry B. Cup dispensing mechanism. U. S. pat. 2,925,196. Filed Dec. 7, 1955. 7 claims. Assigned to The Vendo Co. [Cl. 221-222.] A positively acting mechanism is provided for dispensing the lowermost cup in a nested stack of frustoconical paper cups.

Stow, Robert H. Solvent-resistant pressure-sensitive adhesive tape. U. S. pat. 2,925,174. Filed Nov. 2, 1956. 8 claims. Assigned to Minnesota Mining & Mfg. Co. [Cl. 206-59.]

Wasyluka, Paul. Cellular partition releasably locked in a compartmented shipping container. U. S. pat. 2,925,209. Filed Oct. 24, 1956. 1 claim. Assigned to Crown Zellerbach Corp. [Cl. 229-15.] Four 6-cell partitioning elements are locked into a carton to form a bottle case.

Welsh, Richard F., Jr. Box with manually-relesable latch mechanism. U. S. pat. 2,925,212. Filed June 26, 1957. 4 claims. Assigned to E. I. du Pont de Memours & Co. [Cl. 229-36.] A carton having a hinged cover with tuck-in flap is provided with latching means to hold the cover in closed position.

Whittemore, Harold E. Volumetric feeder. U. S. pat. 2,925,203. Filed Dec. 18, 1957. 10 claims. Assigned to Armstrong Cork Co. [Cl. 222-227.] A layer of plastic flakes is deposited onto a moving web.

Willett, Howard D. Method for erecting boxes. U. S. pat. 2,925,020. Filed July 2, 1956. 2 claims. Assigned to Crown Zellerbach Corp. [Cl. 93-36.] A method is provided for manually erecting a split-cover bottle case on a forming mandrel.

Williamson, John M., and Bogart, Gordon C. Method of packing and a packing and dispensing unit for garment bags. U. S. pat. 2,925,175. Filed Feb. 13, 1959. 8 claims. Assigned to Kordite Corp. [Cl. 206-65.] The bags are wrapped about a paperboard supporting and dispensing member and the assembly is inserted in a carton.

Wood, Andrew C. One-piece flat bottom paper cup. U. S. pat. 2,925,208. Filed Oct. 19, 1956. 1 claim. Assigned to American Can Co. [Cl. 229-1.5.]

Zukoski, Arthur W. Polygonal paperboard boxes. U. S. pat. 2,925,213. Filed Feb. 13, 1956. 1 claim. Assigned to Alton Box Board Co. [Cl. 229-41.] An octagonal carton for coils of electrical cable is constructed to facilitate tucking in the side-wall flaps.

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Alden, Carroll R. Liquid dispensing container and blank therefor. U. S. pat. 2,925,948. Filed Dec. 10, 1954. 4 claims. Assigned to Ex-Cell-O Corp. [Cl. 229-17.] A nondrip pouring spout and opener are provided in a flat-top milk carton.

Beckman, George H., and White, Gerard B. Wrapping machine. U. S. pat. 2,925,696. Filed March 6, 1957. 3 claims. Assigned to Globe Roofing Prods. Co., Inc. [Cl. 53-58.]

Beetz, Jacques R. Apparatus for forming cartons or containers. U. S. pat. 2,925,758. Filed April 3, 1957. 12 claims. Assigned to Alium, S.A. [Cl. 93-51.] Boxes formed from foil or foil-paper laminates have well-defined edges and corners formed by positive folding action.

Boone, Walter S. Hosiery packaging apparatus and method. U. S. pat. 2,925,693. Filed Aug. 6, 1957. 9 claims. Assigned to Waldension Hosiery Mills, Inc. [Cl. 53-21.] A packaging insert is placed into hoisery.

Brown, Dwight C. Collapsible pallets. U. S. pat. 2,925,-947. Filed Sept. 19, 1957. 16 claims. [Cl. 229-14.] The pallet has a partitionlike body construction with facing deck sheets, all of paperboard.

Burg, Michael I. Hat-box construction. U. S. pat. 2,-925,950. Filed July 14, 1958. 3 claims. Assigned to Modern Millinery Box Corp. [Cl. 229-45.] The hexagonal hinged-lid box is provided with means to secure the lid is closed position.

Carter, Sidney T. Labeling machine for applying wrap-around labels. U. S. pat. 2,925,931. Filed June 26, 1956. 42 claims. Assigned to Geo. J. Meyer Mfg. Co. [Cl. 216-13.]

Chaplin, Merle P. Pulp molding machine. U. S. pat. 2,925,863. Filed Oct. 12, 1953. 2 claims. Assigned to Diamond National Corp. [Cl. 162-391.] No part of the molding die is immersed in the pulp mixture longer than any other part, and

improved means for transferring the preform to the drying die are provided.

Cooley, Edwin C. Pulp sheet bundling apparatus. U. S. pat. 2,925,772. Filed Sept. 26, 1956. 8 claims. Assigned to Elk Falls Co. Ltd. [Cl. 100-77.]

Davis, John. Paper bag with integral locking tabs. U. S. pat. 2,925,951. Filed May 21, 1957. 3 claims. Assigned to Equitable Paper Bag Co. Inc. [Cl. 229-77.] Means are provided to hold the closure flap of a bag in closed position.

De Gelleke, Gerrit. Apparatus for controlling the tension in a running web. U. S. pat. 2,925,963. Filed Aug. 28, 1958. 5 claims. Assigned to Cameron Machine Co. [Cl. 242-75.43.]

Fry, George H. Bag handling machines. U. S. pat. 2,925,695. Filed July 24, 1957. 26 claims. [Cl. 53-45.] The mouth of a filled bag is tucked and folded in preparation for sealing.

Gagliardi, Domenick D. Water repellent compositions, products and processes for making same. U. S. pat. 2,926,062. Filed March 5, 1956. 14 claims. Assigned to Gagliardi Research Corp. [Cl. 8-115.5.] Paper and other materials are waterproofed.

Grangaard, Donald H., and Saunders, George H. Manufacture of cellulosic products. U. S. pat. 2,926,114. Filed Aug. 12, 1957. 7 claims. Assigned to Kimberly-Clark Corp. [Cl. 162-16.] Pulp and organic acids are produced by pulping with gaseous oxygen.

Graver, John F. Methods and apparatus for parcelling cartons or the like. U. S. pat. 2,925,946. Filed Jan. 16, 1956. 8 claims. Assigned to Procter & Gamble Co. [Cl. 225-4.] Cartons are taped together to form a unitized merchandizing unit.

Holes, Wilbur W. Photograph album sheet. U. S. pat. 2,925,677. Filed April 15, 1957. 2 claims. Assigned to The Holes-Webway Co. [Cl. 40-159.]

Keim, Gerald I. Wet-strength paper and method of making same. U. S. pat. 2,926,116. Filed Sept. 5, 1957. 10 claims. Assigned to Hercules Powder Co. [Cl. 162-164.] The wet-strength agent provided may be used under acid, alkaline, or neutral conditions.

Kortick, Leonard R. Multicolor silhouette drawing paper. U. S. pat. 2,926,102. Filed Aug. 4, 1958. 1 claim. [Cl. 117-45.]

Locke, Burton H. Folding liquid containers. U. S. pat. 2,925,949. Filed March 14, 1957. 2 claims. [Cl. 229-23.] A reinforcing band about the body of a carton similar to a flat-top milk carton permits lighter weight material to be used in the carton.

Lytton, Marion R. Preparing all skin viscose rayon. U. S. pat. 2,926,099. Filed Dec. 5, 1955. 4 claims. Assigned to American Viscose Corp. [Cl. 106-165.] The coagulation modifier is an alkylene oxide adduct of 1-*m*-hydroxyphenyl-8-*p*-hydroxyphenyl hexadecane.

McCully, Charles R. Ion exchange material from bark and formaldehyde. U. S. pat. 2,926,146. Filed May 28, 1956. 11 claims. Assigned to Armour Research Foundation of Illinois Inst. of Technol. [Cl. 260-2.2.]

Morrow, Harry C. Apparatus for spreading a moving web. U. S. pat. 2,925,640. Filed Sept. 11, 1957. 2 claims. Assigned to U. S. Steel Corp. [Cl. 26-63.]

Ozor, Louis. Device for intucking the mouths of paper bags. U. S. pat. 2,925,699. Filed April 18, 1955. 7 claims. [Cl. 53-371.]

Reeves, Wilson A., and Wade, Ricardo H. Cellulose anthranilate textile fibers and process for making the same. U. S. pat. 2,926,063. Filed July 24, 1958. 7 claims. Assigned to The U. S. Secretary of Agr. [Cl. 8-116.2.]

Reider, Malcolm J. Method for providing long, soft vegetable fibers. U. S. pat. 2,925,626. Filed April 28, 1954. 4 claims. Assigned to Geo. W. Bollman & Co., Inc. [Cl. 19-7.] A method is provided for recovering fibers from bark of kenaf, jute, and the like. The retting solution may include a tall oil soap.

Schoenberger, Philip J. Match package holder. U. S. pat. 2,925,906. Filed Oct. 8, 1956. 1 claim. [Cl. 206-38.] A paperboard folder includes a pocket for matches and a pocket for receiving ashes.

Silver, Stan M. Metered dispensing carton. U. S. pat. 2,925,943. Filed Nov. 22, 1957. 12 claims. [Cl. 222-425.] A carton with integral measuring and dispensing means is set up from a one-piece blank.

Sittel, Karl. Method and apparatus for producing fibrous structures. U. S. pat. 2,925,629. Filed March 25, 1957. 11 claims. Assigned to Walsco Co. [Cl. 19-144.] An electrostatic method and apparatus are provided for forming fibrous mats of flat or curved configuration.

Steinhauser, Armin H., and Revoir, Harold J. Pressure-sensitive adhesive tape. U. S. pat. 2,926,105. Filed July 2, 1956. 2 claims. Assigned to Minnesota Mining and Mfg. Co. [Cl. 117-76.]

Van Beckum, William G., and Miller, Robert W. Cork recovery. U. S. pat. 2,926,115. Filed Aug. 30, 1956. 6 claims. Assigned to The Pacific Lumber Co. [Cl. 162-21.] Douglas-fir bark is subjected to a steam-pressure and explosion process similar to the Masonite method and the fiberized mass is classified to produce a cork-rich fraction.

Walther, Erhardt, and Dämmig, Werner. Package filling. U. S. pat. 2,925,694. Filed Jan. 19, 1954. 6 claims. [Cl. 53-37.] A method of filling a carton is described.

Wassem, Howard M. Roller coating machine for rigid sheet material. U. S. pat. 2,925,800. Filed Jan. 17, 1955. 3 claims. Assigned to Marsh Wall Prods., Inc. [Cl. 118-1.] In coating stiff sheets of hardboard or the like, production of sheets with an uncoated leading edge is prevented.

Weigle, William C., Benedict, Walter E., and Dobry, Joseph F. Method of producing decorative sheet material. U. S. pat. 2,926,100. Filed Dec. 24, 1956. 12 claims. Assigned to Congoleum-Nairn Inc. [Cl. 117-21.] An impregnated felt backing is calendered with pieces of a thermoplastic resin to produce a floor or wall covering.

Wilson, Allen B. Method of forming a container. U. S. pat. 2,925,757. Filed Feb. 16, 1955. 4 claims. Assigned to Acme Steel Co. [Cl. 93-36.5.] The edge of a cylindrical paperboard container is interfolded with a metal rim-forming element.

Wittcoff, Harold. Paper product containing anionic polyamide resin suspensoid. U. S. pat. 2,926,117. Filed May 18, 1953. 7 claims. Assigned to General Mills, Inc. [Cl. 162-168.] The suspensoid improves the wet strength of paper, and may be used when making paper under alkaline conditions.

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Andre, Noble. Carrier for cans and handle. U. S. pat. 2,926,782. Filed Jan. 9, 1956. 4 claims. Assigned to Andre-Matic Machinery Co. [Cl. 206-65.] A handled open-end six-pack can carrier is provided.

Atkins, Horace K. Greeting card mount. U. S. pat. 2,926,444. Filed March 13, 1958. 4 claims. Assigned to Winthrop-Atkins Co., Inc. [Cl. 40-158.]

Benedict, Stephen W., and Kelly, Thomas M. Hydraulic cement compositions. U. S. pat. 2,927,033. Filed June 4, 1957. 13 claims. Assigned to American-Marietta Co. [Cl. 106-90.] Spent sulfite liquor solids are used.

Black, Robert S., and Carroll, James S. Roll type glue spreaders. surface coaters, and the like. U. S. pat. 2,926,628. Filed Sept. 7, 1956. 11 claims. [Cl. 118-244.] The roll used comprises a hard core, a first soft rubbery layer, a second hard rubbery layer, and a grooved surface on the second layer.

Bletzinger, John C., and Nelson, Howard N. Method for making a cellulosic product. U. S. pat. 2,926,394. Filed April 13, 1956. 6 claims. Assigned to Kimberly-Clark Corp. [Cl. 19-144.5.] A tampon is formed.

Bobst, Jacques. Press and a gripper bar device therefor. U. S. pat. 2,926,908. Filed May 1, 1958. 16 claims. Assigned to J. Bobst and Son S.A. [Cl. 271-47.]

Bromberg, Emil. Apparatus for folding and handling newspapers and the like. U. S. pat. 2,926,907. Filed Jan. 4, 1956. 3 claims. [Cl. 271-35.]

Burger, William H., Jr., Nelson, Howard N., and Rowe, Carl H. Cellulose product. U. S. pat. 2,926,667. Filed April 9, 1956. 10 claims. Assigned to Kimberly-Clark Corp. [Cl. 128-285.] A tampon is formed.

Byland, Henry L. Wrapping machine. U. S. pat. 2,926,473. Filed April 25, 1957. 22 claims. Assigned to U. S. Slicing Machine Co., Inc. [Cl. 53-230.] An assembly of food product and card or the like is overwrapped in film.

Chih, Chen Ming. Manufacture of regenerated cellulose sponge material. U. S. pat. 2,927,034. Filed Oct. 25, 1956. 6 claims. Assigned to General Mills, Inc. [Cl. 106-122.]

Cross, Carroll N. Display device and method of making it. U. S. pat. 2,926,441. Filed May 7, 1957. 5 claims. [Cl. 40-120.] An easel-type paperboard device is provided for supporting a desk calendar.

Davis, Chester. Nonstaining transfer sheet. U. S. pat. 2,927,041. Filed Aug. 13, 1957. 13 claims. [Cl. 117-36.] This is similar to U. S. pat. 2,927,040 (March 1, 1960).

Davis, Chester. Nonstaining triarylmethane color base and method of printing therewith. U. S. pat. 2,927,040. Filed Aug. 13, 1957. 21 claims. [Cl. 117-36.] The color base is coated on paper to form a nonstaining transfer sheet.

Dickhens, Donald F., and Huffman, Oscar J., Jr. Cluster pack. U. S. pat. 2,926,781. Filed May 31, 1957. 1 claim. Assigned to Alton Box Board Co. [Cl. 206-45.31.] A unitizing carton for two jars is provided.

Duvall, Thure C. Mixed fiber felt. U. S. pat. 2,926,417. Filed Oct. 19, 1953. 6 claims. Assigned to Wood Conversion Co. [Cl. 28-78.]

Engelhau, Willard G. Method and means of supercalendering. U. S. pat. 2,926,600. Filed Jan. 23, 1958. 9 claims. Assigned to St. Regis Paper Co. [Cl. 100-41.] The web is moved back

and forth across the width of the calender to prevent uneven wear of the calender rolls.

Engleson, Harry E., and Sramek, Elmer D. Life saver package. U. S. pat. 2,926,833. Filed Oct. 18, 1956. 3 claims. Assigned to F. B. Redington Co. [Cl. 229-51.] A tear strip is provided.

Gilbert, Jack H. Resilient finger string anchor eyelet. U. S. pat. 2,926,440. Filed April 20, 1959. 3 claims. [Cl. 40-21.] A string-and-card baggage tag is provided with means to attach the loose end of the string.

Haas, Josef. Method of processing vegetable fibers. U. S. pat. 2,926,391. Filed April 23, 1954. 3 claims. Assigned to International Fiber Devt. Corp. [Cl. 19-7.] Bast fibers are obtained from jute and similar plants.

Jantzen, Johannes K. Sheet transfer mechanism. U. S. pat. 2,926,909. Filed March 17, 1959. 9 claims. Assigned to Miehle-Goss-Dexter, Inc. [Cl. 271-51.] An improved stop gripper mechanism is provided in a printing press.

Kaslow, Arthur L. Refuse receptacle. U. S. pat. 2,926,834. Filed April 22, 1957. 1 claim. [Cl. 229-52.] A paperboard receptacle is provided for use in hospitals for receiving used cleansing tissues and the like.

Kennedy, Mildred S., and Loman, Everett V. Liquid-tight carton and liner. U. S. pat. 2,926,830. Filed Feb. 4, 1958. 3 claims. Assigned to Electronic Wave Prods., Inc. [Cl. 229-14.]

Lanzet, Monroe. Air treating gel and method of preparing the same. U. S. pat. 2,927,055. Filed Sept. 5, 1958. 3 claims. Assigned to Airkem, Inc. [Cl. 167-42.] Sodium carboxymethylcellulose is used.

Lauring, Edgar A. Process of laminating fiber insulation board with an adhesive, process of making said adhesive, and an adhesive composition obtained. U. S. pat. 2,926,722. Filed June 20, 1958. 9 claims. Assigned to Minnesota and Ontario Paper Co. [Cl. 154-28.] A water- and fungi-resistant adhesive of use in laminating board includes modified spent sulfite liquor, starch, and a resorcinol-aldehyde resin.

Lee, George A. Apparatus for feeding and presenting bags for packeting or filling. U. S. pat. 2,926,475. Filed April 19, 1957. 13 claims. Assigned to Autopack, Ltd. [Cl. 53-386.]

Long, David I. Labelling apparatus. U. S. pat.2 ,926,808. Filed Dec. 1, 1955. 2 claims. Assigned to Long and Co. Inc. [Cl. 216-60.] Containers are labeled without danger of applying more than one label to a container.

Long, Florren E. Method of packaging food slices. U. S. pat. 2,927,029. Filed Sept. 24, 1957. 3 claims. Assigned to Continental Can Co., Inc. [Cl. 99-171.] Bacon slices, before packaging, are dusted with sodium carboxymethylcellulose.

Maguire, Frederick A. Combined shipping and display cases. U. S. pat. 2,926,777. Filed March 28, 1957. 2 claims. Assigned to Gibraltar Corrugated Paper Co. [Cl. 206-44.] A shipping case converts to a display stand which displays the merchandise at an elevated level.

Maguire, Frederick A. Display carton with automatic spring flaps. U. S. pat. 2,926,778. Filed Oct. 23, 1957. 7 claims. Assigned to Mead Containers, Inc. [Cl. 206-45.] A shipping case converts to a stand which displays the merchandise at an elevated level.

Marion, Thomas E. Dispenser cartons. U. S. pat. 2,926,-813. Filed Sept. 4, 1957. 3 claims. Assigned to Joseph Shapiro. [Cl. 221-63.] The carton supports and dispenses paper cups from anested stack thereof.

Matthews, William R. Process and apparatus for molding board in a continuous strip. U. S. pat. 2,926,719. Filed June 25, 1953. 14 claims. [Cl. 154-1.] Wood-particle board is formed.

Negro, Kaiji. Flat-top paper milk carton. U. S. pat. 2,-926,832. Filed Dec. 28, 1954. 11 claims. Assigned to Continental Can Co., Inc. [Cl. 229-37.]

Osteen, Belmont D. Combination carrying and display container. U. S. pat. 2,926,780. Filed March 31, 1958. 6 claims. Assigned to Birmingham Paper Co. [Cl. 206-45.21.] A one-piece shipping container for packaged crackers converts to a display stand for the crackers at the point of sale.

Park, John H. Tape dispenser. U. S. pat. 2,926,807. Filed June 13, 1955. 4 claims. [Cl. 216-22.] The width of the tape dispensed may be varied without changing supply rolls.

Rinn, Irwin C. Mounts for transparencies and the like U. S. pat. 2,926,443. Filed Jan. 12, 1956. 4 claims. [Cl. 40-158.]

Ryskiewicz, Edward E. Photosensitive materials and recording media. U. S. pat. 2,927,025. Filed Oct. 23, 1956. 5 claims. Assigned to International Business Machines Corp. [Cl. 96-90.] A paper-base photosensitive material is designed to be responsive to ultraviolet radiation.

Schuessler, Levyn R. Check. U. S. pat. 2,926,933. Filed Dec. 28, 1956. 2 claims. [Cl. 282-27.] Check forms and carbon paper are assembled to form a payroll or voucher check.

Seaver, Alton L., III. Protective coating compositions. U. S. pat. 2,927,036. Filed April 25, 1957. 7 claims. [Cl. 106-177.] Cellulose acetate butyrate is used.

Strange, William M. Infold carton with corner bracing strut. U. S. pat. 2,926,831. Filed Aug. 30, 1957. 3 claims. Assigned to John Strange Carton Co., Inc. [Cl. 229-32.]

Vander Weel, Walter H. Heat sensitive copying sheet. U. S. pat. 2,927,039. Filed March 7, 1957. 10 claims. Assigned to Label-on Tape Co., Inc. [Cl. 117-36.]

Waite, Fred L. Wrapping machine adjusting mechanism. U. S. pat. 2,926,472. Filed Oct. 2, 1956. 14 claims. Assigned to American Machine & Foundry Co. [Cl. 53-203.] A bread wrapping machine is adaptable to wrap loaves of different sizes.

Wegmann, Jacques, and Becker, Carl. Colored shaped structures from viscose and process for their manufacture. U. S. pat. 2,927,035. Filed March 20, 1958. 6 claims. Assigned to Ciba Ltd. [Cl. 106-165.]

Wilcox, Isaac L. Slip cover. U. S. pat. 2,926,812. Filed March 14, 1957. 1 claim. Assigned to Sealright-Oswego Falls Corp. [Cl. 220-42.] A slip-on cover for a paper container carrying a food product is designed to displace residual air from the container when it is emplaced.

Wilkins, Colbert W. Cleavable release coating. U. S. pat. 2,926,829. Filed April 7, 1958. 16 claims. Assigned to Owens-Illinois Glass Co. [Cl. 229-3.5.] A release coating (a polysiloxane and inorganic filler) is provided for application to the interior of a container for asphalt.

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Adams, Robert K. Portable insulated container. U. S. pat. 2,927,720. Filed Nov. 28, 1958. 5 claims. [Cl. 229-14.] The spaced walls of the container are thermally insulated with glass fiber batts; the container is for frozen foods, picnic supplies, etc.

Arpin, Edmund P., Jr. Rotary stock thickener and refiner. U. S. pat. 2,927,738. Filed Oct. 13, 1955. 6 claims. [Cl. 241-80.]

Bartolomeo, Frank T. Screen means for pour openings of paper beverage receptacles. U. S. pat. 2,927,695. Filed Oct. 23, 1957. 11 claims. [Cl. 210-464.] A flat-top paper milk carton with plug-type closure is provided with a screen element which prevents materials from falling into the milk when the closure is open.

Baumgartner, Albert F. Automatic package stamping device. U. S. pat. 2,927,525. Filed Sept. 20, 1957. 15 claims. [Cl. 101-35.] As cartons are advanced along a conveyor, the device stamps the front end and bottom of each carton.

Beachler, Edward D. Paper machine drive. U. S. pat. 2,927,481. Filed Jan. 21, 1958. 9 claims. Assigned to Beloit Iron Works. [Cl. 74-689.]

Bradford, John A. Apparatus for marking and counting containers. U. S. pat. 2,927,527. Filed April 20, 1956. 9 claims. Assigned to Food Machinery and Chemical Corp. [Cl. 101-43.] Produce boxes are marked with a classification and a total of boxes marked in each class is maintained.

Buttery, Kenneth T., and Vander Lugt, Thomas, Jr. Carton and container carton assembly. U. S. pat. 2,927,713. Filed May 31, 1956. 7 claims. Assigned to KVP Sutherland Paper Co. [Cl. 220-85.] A small carton holding an applicator attaches to a can of wax.

Crane, Harold S. Die for pulp molding. U. S. pat. 2,927,-635. Filed March 13, 1958. 9 claims. Assigned to Diamond National Corp. [Cl. 162-411.] The die forms pulp articles, such as food-packaging containers, having a rolled screened edge.

Detert, Ernst-Rolf, and Bucholz, Willi. Method of producing tobacco foils. U. S. pat. 2,927,588. Filed Dec. 10, 1957. 4 claims. Assigned to Eduard Gerlach G.m.b.H. [Cl. 131-15.] Methylcellulose is used.

Freeman, Horace, and Boadway, John D. Cleaning of paper pulp suspensions. U. S. pat. 2,927,693. Filed March 10, 1955. 6 claims. Assigned to Nichols Engineering and Research Corp. [Cl. 209-211.] A vortex-type dirt separator is designed to reduce fiber loss.

Galloway, Robert K. Automatic carton feeding and set-up machine. U. S. pat. 2,927,511. Filed Nov. 9, 1955. 33 claims. [Cl. 93-53.]

Hayes, Dudley W., and Abbott, Leonard E. Carton closing machine. U. S. pat. 2,927,412. Filed March 17, 1955. 20 claims. Assigned to Food Machinery and Chemical Corp. [Cl. 53-376.]

Hollingsworth, Clinton A., Schilling, Karl F., and Wester. Jordan L. Concentration of minerals. U. S. pat. 2,927,692, Filed Dec. 12, 1955. 14 claims. Assigned to Smith-Douglass Co., Inc. [Cl. 209-167.] A flotation process for separating silica from phosphatic materials employs a tall oil-derived reagent.

Johnson, Harold B. Reply letter sheet. U. S. pat. 2,927,-723. Filed June 4, 1957. 3 claims. [Cl. 229-86.] A letter sheet folds into both send and return envelopes.

Kerr, Charles E. Carton closing machine. U. S. pat. 2,927,411. Filed Oct. 22, 1954. 19 claims. Assigned to Food Machinery and Chemical Corp. [Cl. 53-376.]

Lambert, Harry E. Article handling apparatus. U. S. pat. 2,927,512. Filed April 3, 1956. 6 claims. Assigned to Central Fibre Products Co. [Cl. 93-93.] Egg flats are stacked and marked into groups of a certain number.

Lewis, Dan, Jr., and Barton, John S. Coated heat-sealable wrapper and process of making same. U. S. pat. 2,927,865, Filed Feb. 24, 1956. 12 claims. Assigned to Crown Zellerbach Corp. [Cl. 117-14.] A frozen food wrapper comprises a paper base coated with a first layer of pigment and polyvinyl acetate and an outer layer of nonblocking wax.

Look, Willard W., Jr. Ready-made bandage. U. S. pat. 2,927,689. Filed July 24, 1958. 4 claims. [Cl. 206-63.2.] The protective coverings for a band aid-type bandage include strips of frangible plastic and paper placed on either side of the bandage and marginally sealed.

Milne, Bruce L. School bank book. U. S. pat. 2,927,803. Filed Oct. 18, 1957. 1 claim. Assigned to Carpenter Paper Co. [Cl. 282-25.]

Nelson, Howard N. Dispensing carton. U. S. pat. 2,927,714. Filed Sept. 6, 1955. 2 claims. Assigned to Kimberly-Clark Corp. [Cl. 221-48.] An improved dispenser is provided for a pack of interfolded tissues.

Overman, Earl R. Machine for filling containers to predetermined weight. U. S. pat. 2,927,763. Filed Dec. 6, 1954. 14 claims. Assigned to Rock Wool Engineering and Equipment Co., Inc. [Cl. 249-57.] Mineral wool is loaded into paper bags.

Pasjack, Steve. Cartons. U. S. Re. pat. 24,789. Filed Dec. 17, 1957. (Divided; original filed Dec. 20, 1955.) 9 claims. Assigned to Unipak Cartons Ltd. [Cl. 220-105.] A six-pack carton with extensible handle element, for bottles, is described.

Plunkett, Warren L. Apparatus for manufacture of nitrocellulose. U. S. pat. 2,927,845. Filed May 15, 1956. 8 claims. Assigned to Hercules Powder Co. [Cl. 23-285.]

Rouban, Basile. Semiautomatic weight make-up device for weighing pulverulent or fine granulous products. U. S. pat 2,927,764. Filed April 15, 1958. 2 claims. Assigned to Societe Anoyme dite: Les Successeurs de B. Travrou. [Cl. 249-60.] A nearly filled container is brought up to the desired weight.

Ruskin, Henry. Tag attaching stapling machine. U. S. pat. 2,927,323. Filed July 9, 1957. 9 claims. Assigned to Swingline, Inc. [Cl. 1-3.] Tags are stapled to garments.

Sanford, Stuart P. Carton and method of assembly. U. S. pat. 2,927,687. Filed March 2, 1959. 5 claims. Assigned to Westinghouse Electric Corp. [Cl. 206-45.19.] A display carton for mounting several light bulbs is provided.

Tankersley, Benton L. Ice cream filling machine. U. S. pat. 2,927,611. Filed Aug. 13, 1956. 5 claims. [Cl. 141-172.] Cartons are fed, filled, and withdrawn.

Thatcher, Lewis E. One-piece foldable display carton. U. S. pat. 2,927,721. Filed Dec. 6, 1957. 1 claim. Assigned to Gaylord Products, Inc. [Cl. 229-27.]

Turnbull, Roger F., and Lamb, George E. Roll crimping machines. U. S. pat. 2,927,413. Filed March 24, 1958. 9 claims. Assigned to Lamb Grays Harbor Co., Inc. [Cl. 53-380.] A machine for wrapping mill rolls of paper is provided with means to crimp the paper wrapper at the ends.

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Allenbaugh. Ralph. Collating machine. U. S. pat. 2,928,-671. Filed July 16, 1957. 7 claims. Assigned to Cadm Corp. [Cl. 270-58.] Improved drive means are provided for the turntable carrying the supply piles.

Arneson, Edwin L. Collapsible carton. U. S. pat. 2,928,-580. Filed Jan. 29, 1958. 3 claims. Assigned to Federal Paper Board Co., Inc. [Cl. 229-31.] Improved corner constructions and gluability are provided in a flat open-top traylike carton.

Burkhard, George, and Wrist, Peter E. Means for improving drainage on paper machines. U. S. pat. 2,928,466. Filed Dec. 27, 1955. 10 claims. Assigned to Ontario Paper Co. Ltd. [Cl. 162-354.] Some of the table rolls are replaced with transversely positioned bladelike members.

Burton, John A., Helversen, Frederick D., and Hyde, James B. Supply roll support and coupling device. U. S. pat. 2,928,619. Filed April 15, 1957. (Divided; original filed Oct. 10, 1955.) 2 claims. Assigned to Crown Zellerbach Corp. [Cl. 242-68.1.] A support plug is inserted into the core of a paper roll so that the roll may be mounted in a dispensing cabinet.

Caruso, Paul B. Folded rigid cigarette package fitted with lifting insert. U. S. pat. 2,928,571. Filed April 29, 1957. 11 claims. [Cl. 221-247.]

Chirchiglia, Salvatore N. Containers. U. S. pat. 2,928,539. Filed May 9, 1956. 3 claims. [Cl. 206-56.] An elongated carton holds a number of jars in spaced relation and permits withdrawing the jars one at a time from an end of the carton.

Cirillo, Vincent P., Hardwick, William A., and Seeley, Robert D. Fermentation process for producing edible mushroom mycelium. U. S. pat. 2,928,210. Filed Jan. 13, 1958. 6 Claims. Assigned to Anheuser-Busch, Inc. [Cl. 47-1.1.] Edible mushroom mycelium is grown in a liquid culture medium containing spent sulfite liquor.

Drew, Everett G. Drier for sheet material. U. S. pat. 2,928,185. Filed March 19, 1956. 12 claims. [Cl. 34-43.] A Yankee drum construction incudes air jet means for delivering air to the surface of the drum.

Fielding, Francis W. Carton. U. S. pat. 2,928,541. Filed Nov. 12, 1957. 4 claims. Assigned to Lengsfield Brothers, Inc. [Cl. 206-65.] Improved means are provided for retaining cans in an open-end type carton.

Fitch, Leonard W. Gripper with plastic housing for liquid containing cartons. U. S. pat. 2,928,570. Filed June 16, 1958. 14 claims. [Cl. 220-85.] A handled device is provided for supporting a gable-top milk carton during the use thereof.

Ganz, Henry, and Lierman, James D. Surgical dressing. U. S. pat. 2,928,389. Filed April 30, 1958. 7 claims. Assigned to Johnson & Johnson. [Cl. 128-156.] The dressing is formed of folded layers of gauze and cellulose wadding.

Grangaard, Donald H. Manufacture of cellulosic products. U. S. pat. 2,928,868. Filed April 25, 1958. 5 claims. Assigned to Kimberly-Clark Corp. [Cl. 260-515.] Acetic, formic, and other organic acids are produced from spent pulping liquors.

Graybill, Paul J. Reclosable containers. U. S. pat. 2,928,-581. Filed June 6, 1956. 1 claim. [Cl. 229-39.] The closure of a one-piece tuck-top carton may be opened to provide a pouring spout or dispensing orifice.

Graybill, Paul J. Reclosable folding spout containers with tear-flap. U. S. pat. 2,928,579. Filed April 1, 1957. 1 claim. [Cl. 229-17.]

Gross, Frank C. Feeding device for adhesive in solid rod or rope form for coating applicators. U. S. pat. 2,928,370. Filed June 6, 1957. 13 claims. Assigned to Package Machinery Co. [Cl. 118-600.]

Haywood, George L. Method of forming coated abrasives. U. S. pat. 2,928,136. Filed April 10, 1958. (Divided; original filed April 8, 1957.) 3 claims. Assigned to Norton Co. [Cl. 18-56.] A mechanical deformation method is used to form a three-dimensionally shaped abrasive article of abrasive paper.

Hoffman, Robert L. Sifter box and sifter unit therefor. U. S. pat. 2,928,577. Filed July 14, 1958. 8 claims. Assigned to Cross Paper Products Corp. [Cl. 222-555.] The closure of a paperboard container includes a device permitting selective sifting or pouring of the box contents.

Jones, Loren C. Dynamolectric machine winding coil with coil sides and end turns of different flexibility. U. S. pat. 2,928,964. Filed Dec. 23, 1957. 23 claims. Assigned to McGraw-Edison Co. (Cl. 310-208.] The coil insulation is of resin-impregnated paper, mica flakes, and mica paper.

Klein, Clarence F. Tamperproof carton. U. S. pat. 2,929,-582. Filed March 26, 1958. 6 claims. Assigned to Lord Baltimore Press, Inc. [Cl. 229-43.] The carton is for packaging articles mounted on cards.

Kurjan, Homer L. Air filter paper and method of making same. U. S. pat. 2,928,765. Filed Feb. 11, 1957. 19 claims. Assigned to C. H. Dexter & Sons, Inc. [Cl. 162-129.] For use in internal combustion engine air filters, the paper sheet comprises one conventional ply and one ply of redwood bark fibers.

Laakso, Thomas M., and Fowler, William F., Jr. Production of high wet strength paper. U. S. pat. 2,928,736. Filed July 7, 1955. 1 claim. Assigned to Eastman Kodak Co. [Cl. 96-85.] The paper is for photographic use; the agent is a polyaminotriazole-formaldehyde condensate.

Law, Paul G. Envelope. U. S. pat. 2,928,583. Filed Aug. 6, 1954. 7 claims. [Cl. 229-73.] A send-and-return mailer for use in fund-raising compaigns is provided.

Lawrence, Harry J. Oil filter. U. S. pat. 2,928,547. Filed Dec. 28, 1956. 10 claims. Assigned to Perc C. Sorenson and Lee Jewell. [Cl. 210-451.] A container and mounting is provided for an internal combustion engine oil filter element such as a roll of toilet paper.

Leopold, Bengt, Mutton, Donald B., and Saxton, William R. Catalysis of the aging of alkali cellulose. U. S. pat. 2,928,824. Filed Sept. 2, 1958. 6 claims. Assigned to Canadian International Paper Co. [Cl. 260-217.]

Leopold, Bengt, Mutton, Donald B., and Saxton, William R. Catalysis of the aging of alkali cellulose. U. S. pat. 2,928,825. Filed Sept. 2, 1958. 8 claims. Assigned to Canadian International Paper Co. [Cl. 260-233.]

Leopold, Bengt, Mutton, Donald B., and Saxton, William R. Catalysis of the aging of alkli cellulose. U. S. pat. 2,928,826. Filed Sept. 2, 1958. 2 claims. Assigned to Canadian International Paper Co. [Cl. 260-233.]

Locke, Peer A. Paper holder. U. S. pat. 2,928,618. Filed April 26, 1957. 2 claims. [Cl. 242-55.54.] A roll of toilet paper is supported for dispensing.

Parker, Brooks O'C. Materials handling pallet and method of making same. U. S. pat. 2,928,578. Filed Aug. 16, 1956. 10 claims. [Cl. 229-6.] The pallet is made of paperboard.

Paschall, Eugene F. Preparation of propionamide ethers of starch. U. S. pat. 2,928,827. Filed May 9, 1958. 2 claims. Assigned to Corn Products Co. [Cl. 260-233.3.]

Pierson, Hugh C. Grain car door. U. S. pat. 2,928,463. Filed June 7, 1954. 17 claims. [Cl. 160-368.] The door is formed of paper sheets laminated about nylon reinforcing threads.

Rankin, Edward C. Loose leaf binder. U. S. pat. 2,928,-398. Filed April 12, 1956. 1 claim. Assigned to Brock and Rankin, Inc. [Cl. 129-17.]

Schappel, Joseph W. Production of soil-resistant material U. S. pat. 2,928,754. Filed Dec. 31, 1956. 18 claims. Assigned to American Viscose Corp. [Cl. 106-286.] A method is provided for improving the soil resistance of regenerated cellulose fibers.

Schmid-Nisoli, Theodor, Duerig, Gottfried, and Paul, Adolf. Method of absorbing the spray of organic liquids in spraying chambers. U. S. pat. 2,928,498. Filed May 13, 1958. 13 claims. Assigned to Ciba Ltd. [Cl. 183-115.] Stray lacquer spray is absorbed in water containing sodium carboxymethylcellulose or the like.

Shiels, Robert A. Combination separator or divider and display sheet. U. S. pat. 2,928,200. Filed Nov. 29, 1956. 3 claims. Assigned to Excello Paper Products Co. [Cl. 40-310.] A paperboard sheet with peripheral flange is provided as a separator between layers in a stack of bottled goods.

Smith, Henry R. Packaging machine. U. S. pat. 2,928,221. Filed Nov. 8, 1955. 2 claims. Assigned to Henry R. Smith and Ethel Margaret Smith. [Cl. 53-182.] Pockets are formed in a strip of packaging material, the pockets are filled, another strip is sealed over the pockets, and the assembly is severed into separate packs.

Stobie, Cuthbert F. Means for storing and displaying rolls of wallpaper and other rolled fabrics. U. S. pat. 2,928,550. Filed Feb. 27, 1957. 1 claim. [Cl. 211-46.] The rack provided permits examination of any of the rolls without handling any of the other.

Tinsley, John S. Molding composition comprising ethyl cellulose, epoxy compound and phenolic compound and process of preparing. U. S. pat. 2,928,795. Filed Jan. 16, 1957. 14 claims. Assigned to Hercules Powder Co. [Cl. 260-13.]

Western, Arthur W., and Gardner, Roland C. Adjustable slice for flow box. U. S. pat. 2,928,464. Filed Dec. 24, 1957. 10 claims. Assigned to Albert E. Reed and Co. Ltd. [Cl. 162-347.]

Wrist, Peter E. Drainage element for paper machines. U. S. pat. 2,928,465. Filed April 27, 1959. 13 claims. Assigned to Ontario Paper Co. Ltd. [Cl. 162-352.] This is similar to U. S. pat. 2,928,466(March 15, 1960).

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Abrams, Fred, and Walters, Jay C. Method of forming a sales package. U. S. pat. 2,929,180. Filed Aug. 5, 1958. 2 claims. Assigned to Vizofilm Mfg. Corp. [Cl. 53-29.] A produce bag is formed and filled so as to leave an access opening for inspecting the contents.

Armstrong, Zell W. Tape creasing apparatus. U. S. pat. 2,929,303. Filed Aug. 4, 1959. 2 claims. [Cl. 93-84.] Wallboard corner joint tape is longitudinally creased.

Beagle, Melvin J., Jr., and Newman, Hobart H. Double effect evaporators and method of operating same. U. S. pat. 2,929,443. Filed June 4, 1956. 13 claims. Assigned to Whiting Corp. [Cl. 159-20.] A method is provided for operating a double-effect evaporator unit with a rayon spin bath system.

Brooker, Christopher E. Apparatus for folding paper and like material. U. S. pat. 2,929,624. Filed March 4, 1958. 7 claims. Assigned to Jeyes' Sanitary Compounds Co. Ltd. [Cl. 270-39.] Single sheets of paper are interfolded with one another to form a pack of the sheets.

Brown, Edward G. Carton forming machine. U. S. pat. 2,929,302. Filed May 9, 1958. 19 claims. Assigned 50% to Brennan B. West. [Cl. 93-51.] Corner-locking cartons are erected.

Buckman, Stanley J., Pera, John D., and Appling, John W. Processes for the control of iron bacteria and compositions for use therein. U. S. pat. 2,929,758. Filed Sept. 23, 1957. 8 claims. Assigned to Buckman Labs., Inc. [Cl. 162-161.] Papermaking system slime resulting from iron bacteria is inhibited with an N-monoalkyl-substituted dithiocarbamic acid salt.

Collins, Robert L. Apparatus for serving adhesively heat-activated strips and tape. U. S. pat. 2,929,907. Filed Aug. 14, 1957. 8 claims. Assigned to Nashua Corp. [Cl. 219-19.]

Dahlhauser, Anthony H., and Yaeger, Adolph H. Lathing construction. U. S. pat. 2,929,239. Filed May 5, 1958. 1 claim. Assigned to Keystone Steel & Wire Co. [Cl. 72-119.] Wire mesh is secured to a paper laminate.

de Vries, Gerard. Process for mixing coloring material with viscose. U. S. pat. 2,929,731. Filed April 25, 1957. 3 claims. Assigned to American Enka Corp. [Cl. 106-165.]

Farrell, Daniel E. Sliced food package. U. S. pat. 2,929,724. Filed June 25, 1958. 4 claims. Assigned to Milprint, Inc. [Cl. 99-171.] A paperboard backing card for a slab of shingled strips of bacon is provided.

Feder, Edgard. Container. U. S. pat. 2,929,543. Filed March 26, 1958. 11 claims. [Cl. 229-41.] A box similar to a hatbox is formed from a single paperboard blank.

Field, Brenton H., and Mayo, John W. Multicolored asbestos-cement product and process. U. S. pat. 2,929,735. Filed Sept. 17, 1956. 9 claims. Assigned to The Patent and Licensing Corp. [Cl. 117-8.] A wet asbestos-cement sheet is simultaneously embossed and pigmented by an embossing roll which is divided into a number of effective areas.

Fourmanoit, Robert. Machine for the continuous manufacture of asbestos-cement pipes. U. S. pat. 2,929,447. Filed March 7, 1956. 11 claims. Assigned to Johns-Manville Corp. [Cl. 162-284.]

Fry, Horace P., Jr., and Cundiff, Lester B. Drying apparatus for sheet material. U. S. pat. 2,929,153. Filed Nov. 29, 1955. 16 claims. Assigned to American Viscose Corp. [Cl. 34-72.] A cellophane drier prevents overdrying the web edges and recovers plasticizer vaporized during the drying process.

Garber, John D., and Jones, Robert E. Production of 5-hydroxymethylfurfural. U. S. pat. 2,929,823. Filed Nov. 26, 1956. 7 claims. Assigned to Merck & Co., Inc. [Cl. 260-347.8.] The product may be derived from hydrolyzed wood.

Haugwitz, Otto. Compensating mechanism for taping machines and the like. U. S. pat. 2,929,573. Filed Jan. 28, 1957. 1 claim. Assigned to Societe Anonyme Geoffroy-Delore. [Cl. 242-75.45.] A device for winding paper tape on electrical cables is provided with means to control the tape tension.

Herschler, Robert J. Plural-ply paper bag for arctic and tropical climates. U. S. pat. 2,929,544. Filed Sept. 9, 1955. 7 claims. Assigned to U. S. Secretary of the Army. [Cl. 229-55.] An improved seam-forming adhesive composition is provided.

Kurz, Anton W. Suction roll for drying pulp webs, more especially in the paper and cellulose industry. U. S. pat. 2,929,450. Filed July 7, 1958. 11 claims. Assigned to Escher Wyss G.m.b.H. [Cl. 162-370.] Both longitudinal and transverse walls of the suction box may be adjusted in position.

Lytton, Marion R. Preparing viscose rayon. U. S. pat. 2,929,730. Filed Dec. 5, 1955. 4 claims. Assigned to American Viscose Corp. [Cl. 106-165.] The coagulation modifier is an alkylene oxide adduct of *o*-dimethylaminomethylphenol.

McCormick, Edward J., and Muller, William F., Jr. Display device. U. S. pat. 2,929,498. Filed March 5, 1959. 9 claims. Assigned to Johnson & Johnson. [Cl. 206-79.] A paperboard device supports a number of rolls of pressure-sensitive tape for display or cartoning.

Magna, Peter S. Flap-lifting mechanism. U. S. pat. 2,929,-183. Filed Aug. 22, 1958. 6 claims. [Cl. 53-374.] In an automatic packaging line, the outwardly folded flaps of a filled carton are lifted so that they may be folded over and closed by a subsequent device.

Mardon, James, and Nicholl, I. H. Fluid flow distribution devices. U. S. pat. 2,929,499. Filed Aug. 22, 1955. 14 claims. Assigned to Anglo Paper Products, Ltd. [Cl. 162-337.] A device for feeding stock to a headbox of a paper or board machine is described.

Marpillero, Paolo. Method for treating vegetable material with a view to producing paper pulp. U. S. pat. 2,929,757. Filed Jan. 15, 1957. 2 claims. Assigned to Societe Francaise du Xylon. [Cl. 162-88.] Comminuted wood is cooked in caustic, treated with a chlorate activated by catalysts in acid medium, defibrated, and bleached with hypochlorite.

Miller, R. E., and Schleicher, Lowell. Heat and pressure responsive record material. U. S. pat. 2,929,736. Filed July 25, 1957. 4 claims. Assigned to The National Cash Register Co. [C. 117-36.] A paper which is responsive to the combined action of heat and pressure is described.

Million-Czarnecki, Gabryel de. Tuck-in type can carrier and package and blank therefor. U. S. pat. 2,929,497. Filed Feb. 19, 1958. 4 claims. Assigned to Container Corp. of America. [Cl. 206-65.]

Muehlebach, William D., and Stanly, Lynn. Package for tape mounted materials. U. S. pat. 2,929,496. Filed Dec. 14, 1956. 1 claim. Assigned to Chemical Sealing Corp. [Cl. 206-65.] Several rolls of tape, each mounted on a separate paperboard panel, are arranged coaxially in a carton for dispensing.

O'Gorman, William F. Slide box for cigarettes or the like. U. S. pat. 2,929,542. Filed Nov. 1, 1957. 10 claims. Assigned to Garrett Container Corp. [Cl. 229-11.]

Pannier, Ralph A. Carton printer. U. S. pat. 2,929,318. Filed Aug. 5, 1957. 1 claim. Assigned to Pannier Corp. [Cl. 101-231.] One or both sides of a collapsed carton is printed as it passes under revolving dies.

Peters, Guilford B. Clip for joining wirebound containers. U. S. pat. 2,929,527. Filed March 26, 1958. 6 claims. Assigned to Stapling Machine Co. [Cl. 217-13.]

Schuh, Charles H. Production of bamboo pulp and paper. U. S. pat. 2,929,756. Filed Jan. 23, 1958. 6 claims. Assigned to the Government of Burma. [Cl. 162-26.] A mechanical fiber separation and pulping process is described.

Shoumatoff, Nicholas. Single stage continuous papermaking process and apparatus. U. S. pat. 2,929,448. Filed June 16, 1958. 12 claims. Assigned to West Virginia Pulp and Paper Co. [Cl. 162-313.] In the paper machine provided, the web is formed and dried on the surface of a rotating drum, in less than a

Skow, Ross E. Machine for making and applying clasps to envelopes. U. S. pat. 2,929,068. Filed April 10, 1958. (Divided; original filed Oct. 18, 1954.) 18 claims. Assigned to Engineered Specialties Corp. [Cl. 1-95.]

Vawter, Dale. Pulp grinder water control. U. S. pat. 2,929,568. Filed April 16, 1957. 2 claims. [Cl. 241-67.] Water is passed through conduits in the grinding wheel to the grinding surface only when each conduit is in register with the wood-holding pocket of the grinder.

Zuckerman, Adolph M. Printing machine delivery. U. S. pat. 2,929,625. Filed April 28, 1955. 3 claims. Assigned to R. Hoe & Co., Inc. [Cl. 270-72.] A relatively slow speed folding and delivery system is provided for handling the output of a high-speed magazine press.

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Andrews, Walter C. Packaging machine. U. S. pat. 2,930,476. Filed April 30, 1956. 11 claims. Assigned 50% to Alan C. Furth. [Cl. 198-35.] Envelopes containing seeds are selected and arranged in groups for further packaging.

Baranyi, Josef R. Aminoplastic resin impregnated laminates. U. S. pat. 2,930,727. Filed Sept. 26, 1958. 3 claims. [Cl. 154-46.] Decorative laminates of paper and other materials are prepared using as laminating agent a melamine-formaldehyde resin modified with polyvinyl acetate glyoxal, and alpha dichlorohydrin.

Bardy, Peter J. Method and apparatus for binding books and forming plastic binding elements therefor. U. S. pat. 2,930,054. Filed Sept. 12, 1957. 6 claims. Assigned to General Binding Corp. [Cl. 11-1.]

Baxter, Joseph, Jr. Paper machinery. U. S. pat. 2,930,534. Filed Feb. 13, 1957. 13 claims. Assigned to the Black Clawson Co. [Cl. 241-163.] An improved disk refiner is described.

Bebie, Edwin W. Pallet and palletized package. U. S. pat. 2,930,481. Filed July 19, 1956. 12 claims. Assigned to International Paper Co. [Cl. 206-60.] The pallet is formed of paperboard elements.

Cotterell, Maurice S. Bag opening and emptying machine. U. S. pat. 2,930,501. Filed May 2, 1958. 1 claim. [Cl. 214-305.]

Cottrill, Charles E. Double-walled container and method for making same. U. S. pat. 2,930,518. Filed Aug. 29, 1956. 1 claim. Assigned to Standard Packaging Corp. [Cl. 229-51.] A decorative carton includes an integral removable element which is wrapped in protective fashion about the decorative carton body.

Crittendon, Bob C. Stabilization of water-in-oil emulsion. U. S. pat. 2,930,755. Filed Aug. 15, 1955. 5 claims. Assigned to Socony Mobil Oil Co., Inc. [Cl. 252-8.5.] Tall oil is used in compounding a well-drilling fluid.

Dunn, Edward J. Nonblocking pellicle and method for making the same. U. S. pat. 2,930,717. Filed Feb. 1, 1957. 14 claims. Assigned to American Viscose Corp. [Cl. 117-145.] Cellulose films are rendered nonblocking by treatment with sodium methyl orthosiliconate.

Erickson, Harold E., Nelson, Norman E., Nelson, Charles V., and Schubert, Dale L. Mat handling method and apparatus. U. S. pat. 2,930,474. Filed Sept. 2, 1958. (Divided; original filed March 21, 1957.) 5 claims. Assigned to Industrial Development Co. [Cl. 198-31.] A conveyor system is provided for use in a production line for making hardboard or the like.

Fillmann, Karl, and Stephan, Hermann. Device for splicing ends of webs by means of a plurality of longitudinal tapes. U. S. pat. 2,930,427. Filed April 12, 1955. 7 claims. Assigned to Firma Fr. Hesser, Maschinenfabrik-A.G. [Cl. 154-42.3.]

Fowle, Irving H., and Emminger, Francis J. Paperboard container. U. S. pat. 2,930,516. Filed April 21, 1959. 3 claims. Assigned to General Aniline & Film Corp. [Cl. 229-7.] A paperboard carton is provided for use in packaging light-sensitive film.

Glass, William H., and Pier, Jerome R. Filter unit. U. S. pat. 2,930,445. Filed Jan. 29, 1958. 4 claims. Assigned to Westinghouse Air Brake Co. [Cl. 183-4.3.] Oil and water vapor are filtered from air by a unit comprised of metal oxide cartridges in a paper container.

Irish, Laurence K. Material drier and method. U. S. pat. 2,930,140. Filed July 29, 1957. 12 claims. Assigned to Lloyd B. Larsen. [Cl. 34-137.] A drum drier for sawdust or the like loose fibrous material is described.

Jones, Allen P., and Watts, William M. Film shredder having oscillating guide nozzle for twisting web during feed. U. S. pat. 2,930,535. Filed Dec. 6, 1956. 2 claims. Assigned to American Viscose Corp. [Cl. 241-301.] Cellophane is slit and cut to provide a shredded material for use in packaging.

Jones, Wickliffe. Carton sealing apparatus. U. S. pat. 2,930,175. Filed April 3, 1956. 2 claims. Assigned to R. A. Jones and Co., Inc. [Cl. 53-388.]

Labine, Roland A. Machine for wrapping an assembly of cylindrical articles. U. S. pat. 2,930,173. Filed June 14, 1957. 16 claims. Assigned to Package Machinery Co. [Cl. 53-230.] A paper wrapper is folded and sealed about an assembled group of empty cans.

Liebisch, Otto H. Towel dispensing apparatus and method. U. S. pat. 2,930,664. Filed March 18, 1957. 9 claims. Assigned to American Linen Supply Co. [Cl. 312-39.] A wall-mounted dispenser for rolled paper towels holds a reserve roll which is automatically dispensed when the first roll is exhausted.

Lowe, John J. Ribbon package. U. S. pat. 2,930,479. Filed Oct. 13, 1958. 15 claims. Assigned to Burlington Industries, Inc. [Cl. 206-52.] A carton for ribbon rolls permits dispensing the rolls through end or side panels.

Mason, John E. Power-driven paper-feeding mechanism for wrapping machines. U. S. pat. 2,930,171. Filed Feb. 17, 1958. 4 claims. [Cl. 53-74.]

Mensing, Hans-Jürgen, and Kohrig, Gerhard. Folded carton type pack. U. S. pat. 2,930,517. Filed Feb. 25, 1957. 1 claim. [Cl. 229-14.] Liners are attached within outer cartons so as to facilitate the closing of the carton closure flaps.

Moreno, Miguel G. Machine to deposit or feed premiums into containers. U. S. pat. 2,930,174. Filed Dec. 18, 1958. 4 claims. Assigned to Procter & Gamble Co. [Cl. 53-235.]

Navikas, Victor A. Butadiene-styrene-albumin adhesive composition and method of joining members therewith. U. S. pat. 2,930,728. Filed Feb. 26, 1954. 9 claims. Assigned to Armstrong Cork Co. [Cl. 154-89.]

Pearce, Lewis C. Conveyor means for collating machine. U. S. pat. 2,930,611. Filed Aug. 31, 1955. (Divided; original application filed Aug. 10, 1949.) 7 claims. Assigned to American Greetings Corp. [Cl. 271-87.] Greeting cards are collated with envelopes.

Peterson, William R. Apparatus for measuring charges of comminuted material. U. S. pat. 2,930,569. Filed Aug. 10, 1955. 16 claims. Assigned to St. Regis Paper Co. [Cl. 249-43.] The material is preweighed into charges which are fed to a bag-filling operation.

Plant, David N. Coin container and dispenser. U. S. pat. 2,930,519. Filed June 27, 1958. 2 claims. [Cl. 229-92.9.] A child's savings bank or allowance dispenser is formed from superposed sheets of slit and diecut paper and paperboard.

Raddin, Harry A., and Johnson, Donald L. Caul board separator. U. S. pat. 2,930,078. Filed May 23, 1956. 3 claims. Assigned to Miller Hofft, Inc. [Cl. 18-2.] The apparatus provided separates a pressed wood-particle board from its caul and delivers the empty caul for refilling.

Richards, Url S. Mounts for calendars and memorandum pads. U. S. pat. 2,930,557. Filed June 3, 1954. 9 claims. [Cl. 248-35.] This is an easel-type paperboard device which may be collapsed to flat form for writing on the pad.

Ritscher, Arthur. Device for folding sliding boxes for package receptacles. U. S. pat. 2,930,294. Filed May 23, 1956. 4 claims. Assigned to Kurt Körber & Co. [Cl. 93-51.] A die-and-punch type mechanism is provided for folding a blank to form a sliding, or push-open, paperboard box for cigarettes.

Robinson, Frederick C., and Bentley, Norman H. Electrical capacitors. U. S. pat. 2,930,109. Filed April 30, 1956. 1 claim. Assigned to A. H. Hunt (Capacitors) Ltd. [Cl. 29-25.42.] Paper strips having a patterned layer of metallization are used.

Sentz, Lemuel E., and Brosky, John J. Method of sealing spirally wound dynamite containers. U. S. pat. 2,930,275. Filed Nov. 15, 1955. 4 claims. Assigned to American Cyanamid Co. [Cl. 86-1.]

Shorts, Calhoun. Method and apparatus for making fiber-reinforced sheet material. U. S. Re. pat. 24,804. Filed Feb. 21, 1958. (Divided; original filed Oct. 2, 1952.) 40 claims. Assigned to Filon Plastics Corp. [Cl. 154-1.75.] Shaped mats of glass fibers laminated between cellophane are formed.

Sobota, John T. Apparatus for testing the softness of paper products. U. S. pat. 2,930,229. Filed Feb. 4, 1957. 2 claims. Assigned to Fort Howard Paper Co. [Cl. 73-159.]

Stevens, Fred C. Cylindrical article. U. S. pat. 2,930,408. Filed June 28, 1957. 4 claims. Assigned to Richardson Co. [Cl. 138-78.] A cylindrical subdivisible container for explosives of the like is formed from resin-impregnated paper.

Sundblad, Karl Y., and Valfrid, Sigvard. Apparatus for stacking and weighing sheets of wood pulp and the like. U. S. 2,930,493. Filed Nov. 25, 1957. 4 claims. [Cl. 214-2.]

Williams, Robert M., and Baxter, Gene F. Adhesive ingredient and process. U. S. pat. 2,930,772. Filed Sept. 24, 1956. 10 claims. Assigned to American-Marietta Co. [Cl. 260-17.2.] A Douglas-fir bark derivative is used in making a laminating adhesive.

Winders, William D., Sr., and Winders, William D., Jr. Manifold business forms and method of producing them. U. S. pat. 2,930,632. Filed March 6, 1958. 1 claim. [Cl. 282-22.]

The following patents were received later than those of the same issue date and have accumulated during the past quarter.

Oct. 28, 1958

Knoll, Alexander F., and Hurd, Loren C. Method of making pigment and products thereof. U. S. pat. 2,858,230. Filed June 26, 1957. 7 claims. Assigned to Metals Disintegrating Co., Inc. [Cl. 106-277.] An aluminum flake powder pigment of use in various applications (e.g., compounding with asphalt to make a coating composition for roofing materials) is provided.

June 2, 1959

Halbrook, Noah J., and Lawrence, Ray V. Separation of fumaropimaric acid from fumaric-modified rosin products. U. S. pat. 2,889,362. Filed Jan. 10, 1957. 6 claims. Assigned to Secretary of Agriculture. [Cl. 260-514.5.]

June 9, 1959

Schneider, Henry J. Preparation of vinyl sulfides. U. S. pat. 2,890,224. Filed July 15, 1955. 10 claims. Assigned to Rohm & Haas Co. [Cl. 260-329.] Isothiuronium salts are reacted with acetylene and the products are used in treating paper.

June 23, 1959

Fasciati, Alfred. New monoazo-dyestuffs and their manufacture. U. S. pat. 2,891,940. Filed June 27, 1957. 10 claims. Assigned to Ciba Ltd. [Cl. 260-153.] These are for use in coloring pulp and other cellulosic materials.

Fasciati, Alfred, and Riat, Henri. Water soluble triazine azo dyestuffs. U. S. pat. 2,891,941. Filed June 27, 1957. 10 claims. Assigned to Ciba Ltd. [Cl. 260-153.] These are for cellulosic materials.

Aug. 18, 1959

Wasserman, David. Compositions of matter and methods for preparing them. U. S. pat. 2,900,364. Filed Aug. 29, 1955. 10 claims. Assigned to Minnesota Mining and Mfg. Co. [Cl. 260-47.] Various hardenable glycidyl ether compositions are provided for use in impregnating, coating, and laminating paper and other materials.

Sept. 8, 1959

Hwa, Chih M. Antifoam agent and process of inhibiting foam. U. S. pat. 2,903,432. Filed Dec. 27, 1956. 17 claims. Assigned to Dearborn Chem. Co. [Cl. 252-321.] A composition for preventing foam in papermaking systems is provided.

Schmidt-Nickels, Wilhelm, and Smith, Carl M. Polypyrazolone pigments. U. S. pat. 2,903,462. Filed Dec. 23, 1957. 15 claims. Assigned to General Aniline & Film Corp. [Cl. 260-310.] The pigments are of use in paper.

Smith, Carl M. Bis pyrazolones. U. S. pat. 2,903, 461. Filed Dec. 23, 1957. 8 claims. Assigned to General Aniline & Film Corp. [Cl. 260-310.] These are intermediates of use in making paper pigments.

Smith, Carl M. Polypyrazolone pigments. U. S. pat. 2,903,452. Filed Dec. 23, 1957. 14 claims. Assigned to General Aniline & Film Corp. [Cl. 260-240.] The pigments are of use in paper.

Sept. 15, 1959

Bilger, Xavier, and Pechmeze, Jacques. New water-soluble complexes and a process for their preparation. U. S. pat. 2,904,572. Filed Nov. 26, 1956. 4 claims. Assigned to Compagnie Francaise des Matieres Colorantes. [Cl. 260-438.] Fungicidal, fireproofing, and waterproofing agents for paper are formed.

Hanford, William E. Oxidizing baths containing perchlorofluorocarboxylates. U. S. pat. 2,904,515. Filed Sept. 22, 1955. 4 claims. Assigned to Minnesota Mining and Mfg. Co. [Cl. 252-186.] The additives are surfactants which increase the efficiency of bleaching baths for wood pulp and other materials.

Sept. 22, 1959

Hawthorne, John O., and Wilt, Myron H. Method of protecting material against the effects of light. U. S. pat. 2,905,570. Filed Dec. 4, 1957. 5 claims. Assigned to U. S. Steel Corp. [Cl. 117-33.3.] Paper and other materials are protected with a coating including 9-oxa-9,10-dihydrophenanthrene.

Oct. 6, 1959

Katz, Leon, Fuerst, Adolph, and Brouillard, Robert E. Pigment dispersions. U. S. pat. 2,907,670. Filed March 22, 1957. 7 claims. Assigned to General Aniline & Film Corp. [Cl. 106-308.] Pigments which may be used in coloring paper are prepared.

Oct. 13, 1959

Forrester, Gilbert. Process and apparatus for defoaming liquids. U. S. pat. 2,908,652. Filed Aug. 15, 1955. 6 claims. [Cl. 252-321.] Paper-coating compositions are mechanically defoamed.

Oct. 20, 1959

Barnhart, William S. Chromium coordination complexes. U. S. pat. 2,909,545. Filed March 11, 1955. 7 claims. Assigned to Minnesota Mining and Mfg. Co. [Cl. 260-438.] Chromium coordination complexes of perchlorofluoromonocarboxylic acids are claimed as waterproofing agents for paper and the like.

Buc, Saul R. Process for making acylated leucomethylene blue. U. S. pat. 2,909,520. Filed Dec. 6, 1957. 17 claims. Assigned to General Aniline & Film Corp. [Cl. 260-243.] The compound prepared is for use in making transfer papers of the no-carbon-required type.

Hovey, Almon G. Preservative composition comprising pyridinethione and a soluble borate. U. S. pat. 2,909,459. Filed May 22, 1956. 4 claims. Assigned to Olin Mathieson Chem. Corp. [Cl. 167-33.] The fungicide and bactericide may be used in papermaking systems.

Norell, Karl T. Separator for filtering out solids. U. S. pat. 2,909,286. Filed May 11, 1956. 11 claims. Assigned to Aktiebolaget Bofors. [Cl. 210-408.] A filter device is provided for continuously separating solids from a liquid (e.g., separating cellulose or asbestos fibers from a liquid).

Nov. 3, 1959

Andre, Noble. Carton and locking means therefor. U. S. pat. 2,911,096. Filed Sept. 13, 1956. 3 claims. Assigned to Andre-Matic Machinery Co. [Cl. 206-65.] Improved means are provided for locking the end flaps of a wrap-around carton, such as a sleeve-type can carrier.

Freyermuth, Harian B., and Williams, William W. Optical whitener. U. S. pat. 2,911,415. Filed March 30, 1956. 3 claims. Assigned to General Aniline & Film Corp. [Cl. 260-329.3.]

Nov. 10, 1959

Reeves, Wilson A., Guthrie, John D., and Chance, Leon H. Aziridine-phenolic polymers. U. S. pat. 2,912,412. Filed Dec. 4, 1956. 15 claims. Assigned to U. S. Secretary of Agr. [Cl. 260-47.] The polymers are flameproof synthetic resins of various uses in laminating, impregnating, coating, and other papermaking uses.

Nov. 17, 1959

Bachman, Gustave B., and Logan, Ted J. Process for the preparation of nitrohalo polymers. U. S. pat. 2,913,423. Filed Feb. 14, 1958. 11 claims. Assigned to Purdue Research Foundation. [Cl. 260-2.] The polymers are of use in treating paper, apparently to reduce flammability.

Haslam, John H. Fungicide. U. S. pat. 2,913,369. Filed July 5, 1955. 17 claims. Assigned to E. I. du Pont de Nemours and Co. [Cl. 167-30.] Water-repellent fungicides for use in treating pulp and paper are prepared for example by reacting pentachlorophenol with isopropoxy polytitanyl stearate.

Dec. 1, 1959

Richards, William M. S. Preparation of partially frozen liquid mixtures. U. S. pat. 2,915,474. Filed March 4, 1954. 10 claims. Assigned to Celanese Corp. of America. [Cl. 252-182.] A partially frozen mixture of acetic acid and acetic anhydride is prepared for use in cellulose esterification.

Dec. 15, 1959

Powers, James H. Electrostatic gas filter having arrangement for cancelling captured charge. U. S. pat. 2,917,130. Filed Dec. 11, 1957. 3 claims. Assigned to General Electric Co. [Cl. 183-7.] An accordion-folded fibrous sheet material is used in the filter.

Etheridge, Oliver R. Apparatus for pasting or cooking starch. U. S. pat. 2,919,214. Filed Jan. 31, 1958. 9 claims. Assigned to A. E. Staley Mfg. Co. [Cl. 127-28.]

Fiehl, Michael. Card weight. U. S. pat. 2,919,130. Filed Dec. 8, 1958. 6 claims. Assigned to International Business Machines Corp. [Cl. 271-44.] The card-feeding hopper of a business machine is provided with an improved card weight.

Labino, Dominick. Method for making glass paper. U. S. pat. 2,919,221. Filed Jan. 13, 1956. 6 claims. Assigned to L-O-F Glass Fibers Co. [Cl. 162-156.]

Sporka, Arthur F. Production of packages. U. S. pat. 2,919,059. Filed Oct. 26, 1954. 7 claims. Assigned to Tee-Pak, Inc. [Cl. 229-3.5.] Packaging laminates are prepared using a polyethylene film which has been given a surface-modifying treatment so that it adheres to other materials without using adhesive.

LETTERS TO THE EDITOR

Failure of Titanium in Dry Chlorine

To the Editor, *Tappi:*

We recently experienced an incident which could have resulted in serious injury to plant and personnel. This time we were lucky. The incident involved the use of titanium as a corrosion resistant material for use in metering chlorine.

We are reporting this experience to your office with an ideal that it might be worth publishing as a warning to other pulp and paper mills who might be considering use of titanium for this service. Both our chlorine supplier and the instrument manufacturer were unaware of the possibility of explosion.

A brief report of the incident is enclosed.

F. C. Hawks, Jr.
Assistant Resident Manager
Rayonier, Inc.
Fernandina Beach, Fla.

Information circulated recently indicated that titanium was particularly useful in severe bleach plant corrosion problems. Our experience supported this view. When corrosion destroyed the Hastelloy-C rotameter float in our ClO_2 liquor meter, it was replaced with titanium. It has performed extremely well in that service for more than two years. When a new rotameter was purchased for the chlorine system, titanium was used for the float. When this meter was put in service, the titanium float ignited in the dry chlorine gas and was entirely consumed.

Both the instrument supplier and Solvay Technical Service were contacted. Both expressed surprise but found on checking that this reaction was to be expected. Titanium is very resistant to corrosion of chlorine containing solutions but should not be used in dry chlorine.

Until safe moisture limits can be established, application of titanium should be examined carefully. In the instance described, the reaction was so violent that personal injury would have certainly occurred if the entire meter had been constructed of titanium. In the meter under discussion, the float was enclosed in a Hastelloy-C metering tube.

H. G. Taylor

RECENT BOOKS

Do They Understand You? By Wesley Wiksell, Professor of Speech at Louisiana State University. New York, 1960. The Macmillan Co. Cloth, $5^1/_2 \times 8^1/_4$, 200 pages. $4.95.

An interesting book addressed to persons who want to talk and listen effectively, particularly in employer-employee relationships. Tests and observations generally reveal low efficiency. The difficulties exist at all levels. One obstacle appears to be an unwillingness to communicate freely and honestly. Others are blamed for misunderstandings. Often silence is considered to be agreement.

In communicating with men, speaking is of prime importance; a person should listen to his own voice, he should look at his listener and keep his mind on what he is saying. Positive attitudes are important. It should reflect friendliness, avoid offensive words. Employees should be told why. Make sure that you are understood.

Listening is quite as important as talking. It is important to understand your men. Listening helps to avoid grievances. Take time to listen and be sincere in your listening. Be alert to intended meanings.

The aforegoing sketchy survey reveals the nature of a well-written book—on a very important subject.

EMPLOYMENT SERVICE

The rates per issue for Positions Open advertisements in *Tappi* are as follows:

Per line	$ 3
1/16-page box	$ 50
1/8-page Box	$ 80
1/4-page Box	$125

Positions Wanted

E494-60. Production management or technical sales service—folding cartons and paperboard. 23 years diversified experience, including estimating, layouts, production planning, scheduling, purchasing, quality control, technical sales service, customer contact. Experience in letterpress, offset, web flexo, sheet and web diecutting, all types of finishing equipment.

E499-60. Chemical Engineer with 5 years paper mill experience in multiplant technical staff improving quality and reducing costs. Designed and supervised mill experiments, evaluated instruments and operating controls, speeded data feed-back, and trained operators during methods-charge periods. Seeks production supervisory job with technical and/or new specialty development emphasis.

E500-60. Engineer, age 40, with experience in the design of pulping system components and paper machine parts. Has also supervised with construction and the development of pulping processes. Both mill and sales experience.

E501-60. Chemical Engineer with long experience and wide acquaintance in pulp, paper, and paperboard and packaging on Pacific Coast seeks employment in that region with supplier to these industries. Desires sales and technical service work. Willing to travel extensively.

Positions Open

P1005-60. Chemist for fine paper mill location Western Mass. State experience and salary expected.

P1006-60. Paper Coater. Starch and Gum manufacturer has excellent opportunity for technical man with experience in paper coating. Project includes coating adhesive evaluation in coatings and development formulations; location desirable midwest city and pleasant working conditions.

P1008-60. Eastern converter needs experienced man to manage paper coating division. Sizable plant now under construction. New and modern high speed coating lines are on order for specialty and release coatings for the packaging field, pressure sensitive papers, etc. This 55-year-old firm offers excellent opportunity—salary commensurate with experience and ability. Profit sharing and pension.

SALES ENGINEER

Unusually fine opportunity for a technically qualified salesman who has sold to paper mills or who has had paper mill experience.

The man selected for this position must be able to apply his knowledge of paper making and coating to the sale of specialty starches for all such applications.

The position holds excellent promise for advancement with a progressive company in an expanding program.

Salary open—based on experience and education.

Your inquiry with full résumé will receive immediate confidential attention. Reply to **P959-60, Tappi, 360 Lexington Ave., New York 17, N. Y.**

CHEMIST

For applications research on chemicals for new bleaching procedures and new or improved pulping processes. Challenging opportunity to apply theoretical and practical background for development of new and improved methods and for solving important customer problems. Includes research laboratory work and contacts with customers. Prefer applicants with 1 to 10 years experience in paper or cellulose chemistry.

Complete benefit plans. Location in Central New York near the attractive Finger Lakes Area, the Adirondack Mountains, and the Thousand Islands.

Send detailed résumé indicating salary requirements to:

Director of Research
Solvay Process Division
Allied Chemical Corporation
Syracuse 1, New York

(P996-60)

PROJECT CHEMICAL ENGINEER

Recent graduate in chemistry, chemical engineer, or paper school graduate. 2 to 3 years experience in adhesives, coatings, textiles, paper, or paperboard preferred. Under 30. Excellent advancement opportunities in technical department or integrated midwestern paperboard operations. Submit detailed résumé to **Personnel Director, Packaging Corporation of America, Ohio Boxboard Division, Rittman, Ohio.** **(P1008-60)**

RESEARCH AND DEVELOPMENT

Immediate position open in Research and Development Department of absorbent specialty mill located in midwest. Prefer man with degree in chemistry and three years of paper mill experience. Knowledge of saturating paper and saturating resin desirable.

Write to **P1009-60, Tappi, 360 Lexington Ave., New York 17, N. Y.** **(P1009-60)**

PRODUCTION CONTROL CHEMIST

The Dixie Cup Division of the American Can Company has an immediate position available in their Technical Control and Service Department.

Excellent opportunity for chemist of pulp and paper graduate with one to two years quality or technical control experience in the paper industry. Additional experience in the fields of adhesives, waxes, or plastics would be especially desirable but not essential.

Complete program of employee benefits and services, including educational assistance.

Reply, including résumé, to:

Public and Personnel Relations Department
Dixie Cup Division of American Can Company
Easton, Pennsylvania

(P1010-60)

QUALITY CONTROL SUPERVISOR

Excellent opportunity with well established photographic-sensitizing firm for man with B.S. in pulp and paper, forestry, or chemical engineering.

Will supervise Q. C. activities of raw stock material, including acceptance, testing, vendor liaison, production control, etc.

Kindly send résumé and salary requirements to:

Fred A. Weterrings
Industrial Relations Division
Haloid Xerox, Inc.
P.O. Box 1540 Rochester 3, New York

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This assignment calls for a practical rather than a theoretical technician—a profit conscious, down-to-earth fellow, knowledgeable in operating, who not only can develop grades for the mill to make and sell, but also put them on the machines and see to it they are run properly.

Man selected will be a key member of the management team, responsible directly to the president and general manager, a friend of ours of long standing, and one of the most splendid gentlemen to be found anywhere in the industry.

Make initial inquiry in writing to G. M. Sunday personally, enclosing picture and comprehensive résumé covering vital statistics, education, and chronological treatment of background and experience. Full confidence guaranteed. Telephone conference will follow, at which time full details will be revealed and arrangements made for personal interview at client's expense.

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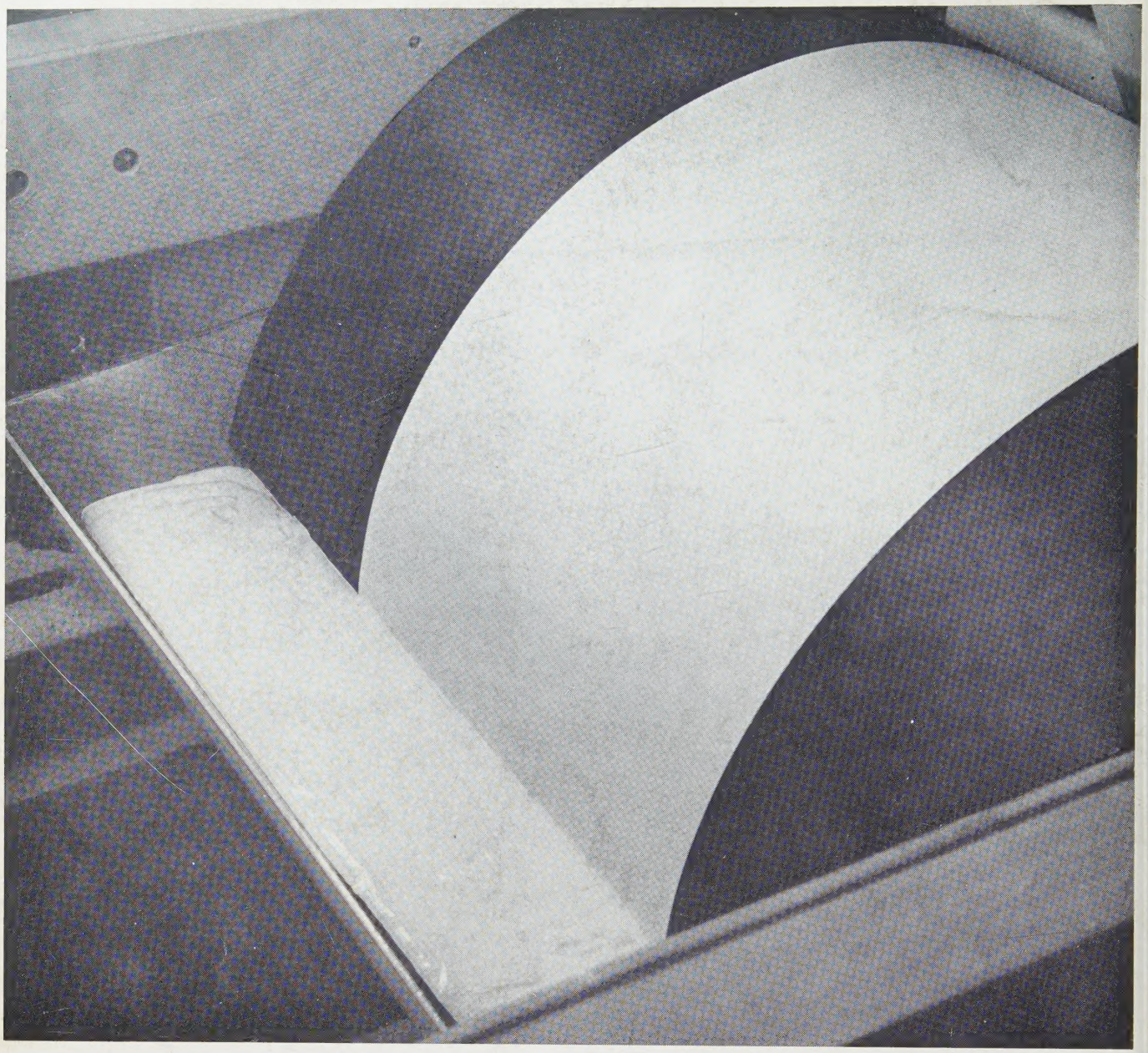

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